# A REVIEW OF THE LAND AND FRESHWATER MOLLUSKS OF IDAHO



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## INTRODUCTION

The state of Idaho has long been known for its diverse and abundant terrestrial snail, slug, and freshwater mollusk fauna. Earliest descriptions of mollusks from this state date to the 1830s and such classic pioneer malacologists as Isaac Lea. Detailed explorations for the most part came later, however, as white settlement and road construction permitted large-scale exploration. Such well-known early naturalists as James Cooper (Coan, 1981) and Wesley Newcomb visited the state and collected mollusks extensively in the 1860s. Henry Hemphill, the itinerant builder and tinker, spent much time in the state, especially in the 1860s, 1880s-1890s, and sporadically thereafter. Curiously, some of the early explorers collected from areas now difficult of access today, such as Florence, Cuprum, and parts of Hells Canyon, *e.g.*, the mouth of the Imnaha. This is often because they followed the old wagon roads and, frequently, visited some of the older mining operations when they were in full swing. Sometimes, knowing the location of the old mule trails into Hells Canyon and the lower Salmon River area has given valuable clues as to the location of some of the old sites. In particular, Henry Hemphill could be very vague at site locations. Given the large number of (especially) terrestrial species collected by Hemphill, such considerations are vital. Some Hemphill type sites remain lost. The classic example is the type locality for *Oreohelix idahoensis idahoensis*, long given, after Hemphill, as "between Coeur d'Alene and the Franklin (Idaho-Utah) mining district [southeastern Idaho]", essentially the whole of the state. A single original slip of Hemphill's saying simply "Lucile" proved much more useful.

Later notable collectors in Idaho included H. B. Baker, primarily in the mid-1930s (mostly terrestrial), H. W. Walton (terrestrial again, mostly in the 1970s) and Alan Solem (1973-1975), here again mostly terrestrial. Junius Henderson and his collaborators collected extensively in the state between 1906 and 1920. Henderson is the first to give a relatively credible list of Idaho mollusks (1924: plus 1936 supplement). We have collected extensively since 1988, particularly in the period between 1988-1994. As regards freshwater taxa, Henderson (1924, 1936) remains a major source; and the efforts of Dwight Taylor, especially from 1981-1987) are particularly important. Taylor also spent a considerable period of time collecting and documenting Idaho fossil mollusks, mostly freshwater. Again, we have collected fairly extensively in the state between 1988-1994 and sporadically since. For details of these efforts, see **REFERENCES** section. Listing of several middle Snake River freshwater snails as Endangered or Threatened federally has also stimulated interest in southern Idaho mollusks, mostly freshwater. The value

of such efforts is limited; but most of this literature is also documented in the **REFERENCES**. Listing, delisting, and relisting of the Bruneau hot springsnail produced its own flurry of work. On the terrestrial side, proposed listing of some 8 Idaho land taxa likewise produced heavy, if regionally focused, new collections and information (see Frest & Johannes,1995a, b for further discussion). Much of the literature developed by these somewhat contentious issues is referenced below and will not be mentioned further.

We have produced several detailed reports on surveys of particular regions of Idaho. These include TNC's Thousand Springs, the middle Snake area generally, the Lower Salmon River land snails, and southeastern Idaho freshwater and land taxa. These reports are also listed in the references. In 1994-1995, the author and R. Hershler (NMNH) and others spent considerable field time in southeastern Idaho surveying for spring snails. This work has partially been published (see Hershler, 1994, 1998, 1999; Hershler et al., 1994; Hershler & Frest, 1996). Some additional publications may be expected. Frest & Johannes have also done a brief run-through of other portions of the state, notably the northern Panhandle counties, including the Clearwater, Lochsa, and Selway drainages; the Lolo Pass area; Henry's Fork; and the Lost and Lemhi Ranges, both for terrestrial land freshwater forms.

Much of this work remains unpublished, due to lack of State or private Idaho funding after 1995. Hershler & Frest are currently looking for outside funding to publish on southern, especially southeastern, Idaho freshwater forms. Enough material is on hand to constitute several monograph-length works; but funding for such is difficult to come by. At present, there remains a very strong need for further such surveying. One more field season is required to complete southeastern Idaho for spring snails. Northern Idaho needs much additional land snail work, as does a part of western Idaho. Southeastern Idaho needs extensive resurveying for land taxa. We recommend that any such funding be directed toward those with considerable experience in the state, as many of the taxa encountered are new or difficult, both in the freshwater springsnails and in the terrestrials. An unfortunate feature of much of the middle Snake work is that it was sometimes done by rather inexperienced workers or non-specialists, oftentimes to fit a political or at least non-neutral mindset, with the result that reported findings cannot necessarily be trusted. Moreover, continued degradation of southern Idaho freshwater habitats and some point occurrences or events, such as the late 90s landslide in the Hagerman-Bliss area and the spill of aquacultural wastes into Box Canyon, mean that these areas need to be rechecked as well.

## IDAHO TERRESTRIAL AND FRESHWATER MOLLUSKS

As intimated above, there is little in the way of complete or reasonably modern lists of Idaho freshwater or terrestrial mollusks available, let along state or even regional guidebooks. Chamberlin & Jones (1929), which contained a number of Idaho records, and Henderson (1924, 1936) is so out of date

now as to be worse than useless. Attempts to modernize Henderson's taxonomy tend to add mistaken records to the State and to overlook those groups in which research is being actively done. Burch (1989) is the only recent freshwater manual available that attempts to cover this area. Unfortunately, Burch was somewhat at his weakest on some of the western states, due to limitations of collections immediately available to him; moreover, hydrobiid research has outpaced this work. Effectively Burch's taxonomy is frozen at around 1982, so that more recent modifications may not be reflected. Nevertheless, his taxonomic framework remains the best and is mostly used here. This work, as well as Burch's very useful freshwater mussel and sphaeriid bivalves manuals, are unfortunately currently out of print. For land snails and slugs, the monographic US work is Pilsbry (1939-1948). This remains the best framework for study, although there have been considerable advances in land snail systematics as well since 1948. This work has also very recently gone out of print. There is a very real need for state manuals, especially for Idaho, Montana, Washington, Oregon, and California. We are currently seeking funding to meet some of these needs.

Frest & Johannes' work for the Clinton Forest Plan (Northwest Forest Plan and ICBEMP) has provided a framework for mollusk conservation on federal lands in the regions covered by their respective management plans. In this context, they have summarized the results of visits to in excess of 4,500 land and freshwater mollusk sites from 1988-1998 in the Pacific Northwest [results from a total of about 6,000 sites will be included in Frest & Johannes, in press]. The original documents for both areas are available; and we have a revision of both in press. Included are results from about 1,000 Idaho sites. At least 750 of these are included herein. This work, literature review, and museum collection visits have enabled me to come up with a new list of Idaho freshwater and terrestrial mollusks (**Tables 1 & 2** below). For more information about data sources, taxonomy, etc., see **SPECIES DISCUSSIONS** and **REFERENCES** sections below. For the following sections, reference to the **GLOSSARY** may also be helpful.

I follow these introductory materials with two tables outlining the names (common and scientific), status, and rough distribution of mollusks known to occur in Idaho. Terminology is mostly that of Turgeon *et al.* (1998), with some additions from Frest & Johannes (1998a, in press). Sensitive species are defined as in Forest Service-BLM parlance and as used in the **SPECIES DISCUSSIONS** below. Most such species are globally rare and really should be federally listed under the ESA. My recommendations for each are noted under individual species discussions. I had some difficulty fitting within the usual TNC framework. This related to definition of occurrences and sites. Many of the narrowly endemic terrestrial taxa probably historically originally occurred in single large colonies that have become fragmented only in recent times. In other cases. there were likely originally several colonies separated by major river or lithologic boundaries. I have tried to specify original condition for each and then to state total number of known colonies. In cases where individual arguments are not made, it may be assumed that the species was originally widespread or occurred in numerous discrete colonies. The argument for large single (or just a few) colonies applies primarily to terrestrial forms in the lower Salmon River drainage, Hells Canyon, parts

of the Clearwater drainage, including the Lochsa and Selway, and much of southeastern Idaho; but only to certain taxa, as specified (mostly narrow endemics that are poor dispersers). Many other taxa in these same areas, as elsewhere in the state, are more widely distributed. Still, it should be borne in mind that all land snails have suffered major reductions in their range (estimated regionally at 90% or better even for common species in Della Salla *et al.*, 1999).

Rather similar arguments apply to freshwater forms. Certain of the hydrobiids and other forms that have been termed cold water taxa (cold stenothermal taxa; cold homoiothermiphile taxa) formerly also tend to high rates of endemism and very narrow ranges, with many known from single sites or a few, often springs. There are also a very few warm-water endemic mollusks in Idaho for which similar arguments can be made (some of these, that is, are poikilothermiphiles; but some are actually warm homoiothermiphile taxa; termed simply thermiphiles herein). These also are poor dispersers as compared to many pulmonates or sphaeriid clams (see general discussions below). Here again, specific site numbers are given; but in this case, there is every reason to assume that many of these have always has a fragmentary distribution. Still, prior to widespread settlement and development, cold water habitat and warm spring habitat was unquestionably much more widespread than at present. Moreover, as with the terrestrial taxa there appear to be a few cold water forms which are adapted to rivers and streams. These amniphile forms may also have existed originally as one or a very few very large colonies, *e.g.* all of the middle Snake (the listed middle Snake snails, with the exception of the Banbury lanx), all of the middle Snake and Hells Canyon, etc. (*Fisherola nuttalli*, *Fluminicola fuscus*). In a number of cases, amniphile taxa may have originally been widespread in single creeks or rivers, *e.g.* the Teton River pyrg, *Fluminicola coloradensis*, etc. In only a few cases are cold or warm spring endemics widespread: *Pyrgulopsis kolobensis*, *Pyrgulopsis pilsbryana*, & *Colligyrus greggi* are perhaps Idaho examples (see Hershler, 1999). In some of these cases, however, it appears to some that detailed examination suggests that they are actually species complexes, each member of which has a narrow distribution (Frest & Johannes, 1999). This one is an additional subject which Hershler and I would like to address if further funding is found, requiring DNA work for proper disposal. Note also that, as the purely descriptive phase of work begins to wind down, detailed phylogenetic work will be done on the more speciose forms, such as *Pyrgulopsis*, *Fluminicola*, *Oreohelix*, and *Cryptomastix*. Preliminary results with both *Pyrgulopsis* and *Oreohelix* suggest that endemism is higher than suspected from use of other methods; and that each generic-level taxon may be split into several to many independent high-level taxa in the end. Note also that presently discriminated taxa are all more or less "obvious" forms; it is quite possible that numerous so-called cryptic taxa remain to be discovered.

I have tried to do a full discussion for each Sensitive taxon; and shorter discussions for many others. If no such discussion is present, it may be assumed either 1) that the taxon is widespread, likely or known to be found at many Idaho locations and in no danger of local or regional extinction; or that 2) insufficient information is available to allow extended discussion. It may also be assumed that literature

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO.

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS (Native)** | | |
| *Allogona* (*Allogona*) *lombardii* Smith, 1943 | Selway forestsnail | Idaho endemic: Sensitive |
| *Allogona* (*Dysmedoma*) *ptychophora ptychophora* (Brown, 1870) | Idaho forestsnail | Very common in Washingtonian Province |
| *Allogona* (*Dysmedoma*) *ptychophora solida* Vanatta, 1924 | dry land forestsnail | Sensitive taxon; Hells Canyon, Lower Salmon |
| *Ancotrema* (*Ancomena*) *hybridum* (Ancey ,1888) | Oregon lancetooth | rare; northern Idaho only? |
| *Ancotrema* (*Ancomena*) *sportella sportella* (Gould, 1846) | beaded lancetooth | rare; northern Idaho only |
| *Anguispira kochi occidentalis* (Von Martens, 1882) | western banded globe | Washingtonian endemic; not as yet Sensitive in Idaho |
| *Anguispira nimapuna* Baker, 1932 | Nimapuna disc | Idaho endemic; less than 10 extant sites |
| *Carychium occidentale* Pilsbry, 1891 | western thorn | May be present in the Panhandle and LSR |
| *Catinella rehderi* (Pilsbry, 1948) | chrome ambersnail | May be present in the Panhandle |
| *Catinella vermeta* (Say, 1824) | suboval ambersnail | seemingly widespread in Idaho; see next |
| *Cionella lubrica* (Müller, 1774) | glossy pillar | found both as Introduced and native populations: native may represent another species; see Frest & Johannes (1995) |
| *Columella alticola* Ingersoll, 1875 | Rocky Mountain column | May be present in the Panhandle and LSR |
| *Columella "edentula"* (Draparnaud, 1805) | toothless column | May be present in the Panhandle and LSR |
| *Cryptomastix* (*Bupiogona*) *populi* (Vanatta, 1924) | poplar oregonian | LSR-Hells Canyon endemic: Sensitive |
| *Cryptomastix* (*Bupiogona*) n. sp. 1 Frest & Johannes, 1995 | Deep Creek oregonian | Idaho Hells Canyon endemic: single valley |
| *Cryptomastix* (*Bupiogona*) n. sp. 2 Frest & Johannes, 1995 | Kinney Creek oregonian | Idaho Hells Canyon endemic: single valley |
| *Cryptomastix* (*C.*) *hendersoni* (Pilsbry, 1928) | Columbia Gorge oregonian | probably not present in Idaho |
| *Cryptomastix* (*Cryptomastix*) *harfordiana* (Binney, 1878) | Salmon oregonian | LSR endemic; many sites in small area |
| *Cryptomastix* (*Cryptomastix*) *magnidentata* (Pilsbry, 1940) | Mission Creek oregonian | Idaho endemic: 1 site in 1 small creek drainage |
| *Cryptomastix* (*Cryptomastix*) *mullani blandi* (Binney, 1878) | Bland oregonian | Idaho (Coeur d'Alene) endemic; 2 sites |
| *Cryptomastix* (*Cryptomastix*) *mullani clappi* (Hemphill, 1897) | River of No Return oregonian | LSR endemic; few sites |
| *Cryptomastix* (*Cryptomastix*) *mullani hemphilli* (Binney, 1886) | Hemphill oregonian | Panhandle endemic; few current sites |
| *Cryptomastix* (*C.*) *mullani latilabris* (Pilsbry, 1940) | wide-lipped oregonian | LSR endemic; very few sites |
| *Cryptomastix* (*C.*) *mullani mullani* (Bland & Cooper, 1861) | Coeur d'Alene oregonian | Common in Washingtonian region |
| *Cryptomastix* (*C.*) *mullani olneyae* (Pilsbry, 1891) | Spokane oregonian | Common in northern Idaho |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO. (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS** | | |
| *Cryptomastix* (*C.*) *mullani tuckeri* (Pilsbry & Henderson, 1930) | scaled oregonian | Idaho (Clearwater) endemic; few sites (originally 2?) |
| *Cryptomastix* (*C.*) n. sp. 1 Frest & Johannes 1995 | Lochsa oregonian | Sensitive; lower Lochsa, a few miles of the Clearwater corridor; narrow endemic |
| *Cryptomastix* (*C.*) n. sp. 2 Frest & Johannes 1995 | Hells Canyon oregonian | Sensitive; few sites |
| *Cryptomastix* (*C.*) n. sp. 3 Frest & Johannes 1995 | disc oregonian | Sensitive; few sites; LSR-northern Hells Canyon endemic |
| *Cryptomastix* (*Cryptomastix*) n. sp. 5 | Lucile oregonian | Sensitive; LSR endemic |
| *Cryptomastix* (*Cryptomastix*) n. sp. 6 | White Bird oregonian | Sensitive: LSR endemic |
| *Cryptomastix* (*C.*) *sanburni* (Binney, 1886) | Kingston oregonian | Sensitive; not collected recently; Panhandle only |
| *Discus marmorensis* Baker, 1932 | marbled disc | Sensitive; LSR endemic |
| *Discus whitneyi* (Newcomb, 1864) | forest disc | widespread in Idaho and elsewhere |
| *Euconulus fulvus alaskensis* Pilsbry, 1906 | western hive | uncommon in both provinces in Idaho |
| *Haplotrema* (*Haplotrema*) *vancouverense* (Lea 1839) | robust lancetooth | rare; northern Idaho only; abundant elsewhere |
| *Hawaiia minuscula* (Binney, 1840) | minute gem | rare in Washingtonian in Idaho and elsewhere; also Rocky Mountain |
| *Helicodiscus salmoneus* Binney, 1886 | Salmon coil | Uncommon in Washingtonian Idaho; not Sensitive |
| *Microphysula ingersolli ingersolli* (Bland, 1874) | spruce snail | Uncommon but widespread in Washingtonian Idaho and elsewhere |
| *Nesovitrea binneyana occidentalis* (Baker 1930) | western blue glass | Rare in northern Idaho; but possibly not Sensitive |
| *Nesovitrea electrina* (Gould 1841) | amber glass | Rare in northern Idaho; but possibly not Sensitive |
| *Ogaridiscus subrupicola* (Dall, 1877) | southern tightcoil | Found elsewhere (OR, UT) but likely Sensitive |
| *Oreohelix hammeri* Fairbanks, 1984 | Mt. Sampson mountainsnail | Sensitive; Seven Devils endemic |
| *Oreohelix haydeni hesperia* Pilsbry, 1939 | western mountainsnail | Sensitive: LSR endemic |
| *Oreohelix haydeni perplexa* Pilsbry, 1939 | enigmatic mountainsnail | Sensitive: only one LSR site |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS** | | |
| *Oreohelix idahoensis baileyi* (Bartsch, 1916) | Seven Devils mountainsnail | Idaho endemic; 1 site, Hells Canyon |
| *Oreohelix idahoensis idahoensis* (Newcomb, 1866) | costate mountainsnail | Sensitive: a number of sites probably originally one or a handful |
| *Oreohelix intersum* (Hemphill, 1890) | deep slide mountainsnail | Sensitive: Little Salmon R. endemic; few sites |
| *Oreohelix jugalis* (Hemphill, 1890) | boulder pile mountainsnail | Sensitive; more sites than others but limited range |
| *Oreohelix* n. sp. 8 Frest & Johannes, 1995 | Squaw Creek mountainsnail | Sensitive Little Salmon endemic; few sites |
| *Oreohelix* n. sp. 9 Frest & Johannes, 1995 | Bluebird Canyon mountainsnail | Sensitive; 1 site only; Lost R. Mts. endemic |
| *Oreohelix* n. sp. 12 Frest & Johannes, 1995 | hackberry mountainsnail | Sensitive; Rapid River endemic; very few sites |
| *Oreohelix* n. sp. 13 Frest & Johannes, 1995 | Rapid River mountainsnail | Sensitive; Rapid River endemic; very few sites |
| *Oreohelix* n. sp. 14 Frest & Johannes, 1995 | limestone mountainsnail | Sensitive; Rapid River endemic; very few sites |
| *Oreohelix* n. sp. 15 Frest & Johannes, 1995 | speckled mountainsnail | Sensitive; River of No Return River endemic; very few sites |
| *Oreohelix* n. sp. 16 Frest & Johannes, 1995 | rugose mountainsnail | Sensitive; Idaho S. Hells Canyon; essentially 1 colony |
| *Oreohelix* n. sp. 17 Frest & Johannes, 1995 | bicarinate mountainsnail | Sensitive; Idaho S. Hells Canyon; essentially 1 colony |
| *Oreohelix* n. sp. 18 Frest & Johannes, 1995 | Limestone Point mountainsnail | Sensitive; N. Hells Canyon; very few live sites; WA site extirpated |
| *Oreohelix* n. sp. 19 Frest & Johannes, 1995 | Shingle Creek mountainsnail | Sensitive; LSR endemic; very few sites |
| *Oreohelix* n. sp. 20 Frest & Johannes, 1995 | Sheep Gulch mountainsnail | Sensitive; LSR endemic; very few sites |
| *Oreohelix* n. sp. 21 Frest & Johannes, 1995 | Box Canyon mountainsnail | Sensitive; LSR endemic; very few sites |
| *Oreohelix* n. sp. 22 Frest & Johannes, 1995 | Slate Creek mountainsnail | Sensitive; LSR endemic; very few sites |
| *Oreohelix* n. sp. 23 Frest & Johannes, 1995 | Lucile mountainsnail | Sensitive; LSR endemic; very few sites |
| *Oreohelix* n. sp. 24 Frest & Johannes, 1995 | Wet Gulch mountainsnail | Sensitive; LSR endemic; one site |
| *Oreohelix* n. sp. 25 Frest & Johannes, 1995 | Stites mountainsnail | Sensitive; Clearwater-LSR endemic |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS** | | |
| *Oreohelix* n. sp. 27 Frest & Johannes, 1995 | Pass Creek mountainsnail | Sensitive; Lost R. Range only |
| *Oreohelix* n. sp. 28 Frest & Johannes, 1995 | quartzite mountainsnail | Sensitive; vicinity of Soda Springs only |
| *Oreohelix* n. sp. 29 Frest & Johannes, 1995 | Hells Canyon mountainsnail | Sensitive; part of northern Hells Canyon only |
| *Oreohelix* n. sp. 32 Frest & Johannes, 1995 | Skookumchuck mountainsnail | Sensitive; LSR endemic |
| *Oreohelix strigosa depressa* (Gould, 1846) | depressed mountainsnail | Widespread in northern and southeastern Idaho; but probably a complex of species, none of which are likely identical to those in the type area |
| *Oreohelix strigosa goniogyra* Pilsbry, 1934 | striate mountainsnail | Sensitive; LSR endemic |
| *Oreohelix strigosa* n. subsp. 1 Frest & Johannes, 1995 | Nez Perce mountainsnail | Sensitive; central Idaho only |
| *Oreohelix strigosa strigosa* (Gould, 1846) | Rocky mountainsnail | May not be present in Idaho, despite literature reports; probably other taxa, some common |
| *Oreohelix tenuistriata* Henderson & Daniels, 1916 | thin-ribbed mountainsnail | Sensitive; Portneuf valley endemic; 1 site |
| *Oreohelix vortex* Berry, 1932 | whorled mountainsnail | Sensitive; LSR endemic |
| *Oreohelix waltoni* Solem, 1975 | lava rock mountainsnail | Sensitive LSR endemic |
| *Oxyloma hawkinsi* (Baird, 1863) | boundary ambersnail | Idaho distribution poorly known |
| *Oxyloma nuttallianum* (Lea 1841) | oblique ambersnail | Idaho distribution poorly known |
| *Paralaoma caputspinulae* Reeve, 1855 | striate spot | Northern Idaho only; may be rare in state, but not elsewhere |
| *Planogyra clappi* (Pilsbry, 1898) | western flat-whorl | Northern Idaho only; may be rare in state, but not elsewhere |
| *Polygyrella polygyrella* (Bland & Cooper, 1861) | humped coin | Sensitive?; found also in WA , OR, MT but few sites anywhere; Idaho sites most numerous; Washingtonian only |
| *Pristiloma* (*Pristinopsis*) *arcticum arcticum* Lehnert, 1884 | northern tightcoil | Northern Idaho only, if present |
| *Pristiloma* (*Priscovitrea*) *chersinella* (Dall, 1886) | black-foot tightcoil | northern Idaho only, if present |
| *Pristiloma* (*Priscovitrea?*) *wascoense* (Hemphill 1911) | shiny tightcoil | Sensitive?; Washingtonian; likely composite; few live sites in Idaho or elsewhere |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS (Native)** | | |
| *Pristiloma* (*Pristinopsis*) *idahoense* Pilsbry, 1902 | thinlip tightcoil | Washingtonian; Sensitive; seemingly now very rare; found in eastern WA also |
| *Pupilla hebes* (Ancey, 1881) | crestless column | Washingtonian; uncommon but not rare |
| *Radiodiscus* (*Radiodomus*) *abietum* Baker, 1930 | fir pinwheel | Washingtonian, few Idaho sites but probably underrepresented |
| *Striatura pugetensis* (Dall, 1895) | northwest striate | May be present in the Panhandle counties |
| *Succinea gabbi* Tryon, 1866 | riblet ambersnail | Idaho distribution poorly known |
| *Succinea rusticana* Gould, 1846 | rustic ambersnail | Idaho distribution poorly known |
| *Vertigo concinnula* Cockerell, 1897 | mitered vertigo | Widespread but uncommon in Washingtonian |
| *Vertigo idahoensis* Pilsbry, 1934 | Idaho vertigo | small part of central western Idaho; not collected recently; should be Sensitive |
| *Vertigo modesta modesta* (Say, 1824) | cross vertigo | Northern Idaho only; uncommon but in no danger elsewhere in Washingtonian |
| *Vertigo ovata ovata* Say, 1822 | ovate vertigo | Northern Idaho only; uncommon but in no danger elsewhere in Washingtonian |
| *Vallonia cyclophorella* Sterki, 1892 | silky vallonia | Widespread in state in both Rocky Mountain and Washingtonian areas. |
| *Vitrina pellucida* (Müller, 1774) | western glass-snail | Widespread in state in both Rocky Mountain and Washingtonian areas. |
| *Zonitoides arboreus* (Say, 1816) | quick gloss | Widespread in state in both Rocky Mountain and Washingtonian areas. |
| *Zonitoides nitidus* (Müller, 1774) | black gloss | Dubiously ascribed to the state |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **LAND SNAILS (Introduced)** | | |
| *Oxychilus alliarius* (Miller ,1822) | garlic glass-snail | Urban areas only |
| *Oxychilus cellarius* (Müller, 1774) | cellar glass-snail | Urban areas only |
| *Oxychilus draparnaudi* (Beck, 1837) | dark-bodied glass-snail | Urban areas only |
| *Cepaea nemoralis* (Linnaeus, 1758) | grovesnail | Urban areas only |
| *Helix aspersa* Müller ,1774 | brown gardensnail | Urban areas only |
| **SLUGS (Introduced)** | | |
| *Limax* (*Limax*) *maximus* Linnaeus, 1758 | giant gardenslug | Urban areas and becoming naturalized; mostly Northern |
| *Lehmannia valentiana* (Férussac, 1823) | three band gardenslug | Urban areas and becoming naturalized; mostly Northern |
| *Deroceras laeve* (Müller, 1774) | meadow slug | Widespread; partly native; naturalized |
| *Deroceras reticulatum* (Müller, 1774) | gray gardenslug | Widespread; naturalized |
| *Arion* (*A.*) *ater ater* (Linnaeus,1758) | black arion | Urban areas and becoming naturalized; mostly Northern |
| *Arion* (*A.*) *ater rufus* (Linnaeus, 1758) | red arion | Urban areas and becoming naturalized; mostly Northern |
| *Arion* (*Kobeltia*) *hortensis* Férussac, 1819 | garden arion | Urban areas |
| *Arion* (*Kobeltia*) *distinctus* Mabile, 1868 | no common name | Urban areas |
| *Arion* (*Kobeltia*) *owenii* Davies, 1979 | no common name | Urban areas |
| *Arion* (*Microarion*) *intermedius* Normand, 1852 | hedgehog arion | Urban areas |
| *Arion* (*Mesarion*) *subfuscus* (Draparnauld, 1805) | dusky arion | Urban areas and becoming naturalized; mostly Northern |
| *Arion* (*Carinarion*) *circumscriptus* Johnston, 1828 | brown-banded arion | Urban areas |
| *Milax gagates* (Draparnauld, 1801) | greenhouse slug | Urban areas |

## TABLE 1. TERRESTRIAL MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | COMMENTS |
|---|---|---|
| **SLUGS (Native)** | | |
| *Prophysaon andersoni* (Cooper, 1872) | reticulate taildropper | reported North; but unlikely |
| *Prophysaon humile* Cockerell, 1890 | smoky taildropper | Northern only; becoming rare |
| *Hemphillia camelus* Pilsbry & Vanatta, 1897 | pale jumping-slug | Northern only; becoming rare; may represent two species |
| *Magnipelta mycophaga* Pilsbry, 1953 | magnum mantleslug | extreme northern only; Sensitive |
| *Udosarx lyrata lyrata* Webb, 1959 | lyre mantleslug | part of northern only; Sensitive |
| *Zacoleus idahoensis* Pilsbry, 1903 | sheathed slug | Northern only; becoming rare |
| *Ariolimax columbianus* (Gould,1851) | Pacific bananaslug | Northern only |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO.

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Valvata humeralis* Say, 1829 | glossy valvata | Sporadic over whole state, mostly northern and southeastern; should be Sensitive in Idaho? |
| *Valvata* n. sp. 1 Frest & Johannes, 1995 | Salmon valvata | Few spring sites in Lower Salmon River drainage: Sensitive |
| *Valvata sincera* Say, 1824 | mossy valvata | Upper Snake only; rare in Idaho but in good condition elsewhere |
| *Valvata tricarinata* (Say, 1817) | threeridge valvata | northern Panhandle only; rare in Idaho but in good shape elsewhere |
| *Valvata utahensis* Call, 1884 | desert valvata | Middle and formerly upper Snake; rarely in limnocrenes or spring-fed creeks, central-SE Idaho; Sensitive |
| *Cipangopaludina chinensis malleata* (Reeve, 1863) | Chinese mysterysnail | Introduced; sporadic to S. side of state; rarely to N. |
| *Cipangopaludina japonicus* (Martens, 1861) | Japanese mysterysnail | Introduced; sporadic to S. side of state; rarely to N. |
| *Marisa cornuarietis* (Linnaeus, 1758) | giant rams-horn | Introduced; middle Snake tributaries |
| *Pomacea* spp. | applesnails | Introduced; middle Snake tributaries.; most likely *haustrum* (Reeve, 1858), the titan applesnail; but other taxa may be present also |
| *Tarebia granifera* (Lamarck, 1822) | quilted melania | Introduced; middle Snake tributaries and SE ID; most likely subspecies *mauiensis*; but others seen as dead shells. |
| *Pristinicola hemphilli* (Pilsbry 1890) | pristine springsnail | Sporadic over northern 1/3 of state and west of Hells Canyon; uncommon in Idaho; more common elsewhere |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Colligyus greggi* (Pilsbry, 1935) | Rocky Mountain duskysnail | SE ID; possibly N. ID as well; ?Sensitive |
| *Fluminicola coloradensis* Morrison, 1940 | Green River pebblesnail | Extreme SE ID; rather rare; Sensitive |
| *Fluminicola fuscus* (Haldeman, 1847) | ashy pebblesnail | Former candidate under the name *columbiana*; extinct? in middle Snake; Hells Canyon and lower Salmon with good populations; Sensitive. |
| *Fluminicola minutissimus* Pilsbry, 1907 | pixie pebblesnail | Sensitive; 1 site in Weiser drainage; may be extinct |
| *Fluminicola* undescribed species (A & B groups of text) | undescribed pebblesnails | About 7 undescribed taxa known over the state; range from common to highly restricted; see Frest & Johannes (1995, 1997) and Hershler & Frest (1996) for details |
| *Potamopyrgus antipodarum* (Gray, 1843) | New Zealand mudsnail | Introduced; now to Boise R.; all of Snake except Hells Canyon; Pahsimeroi; spreading into SE streams |
| *Pyrgulopsis bruneauensis* Hershler, 1990 | Bruneau hot springsnail | Sensitive; single creek-Bruneau R. endemic; few live sites |
| *Pyrgulopsis idahoensis* (Pilsbry, 1933) | Idaho springsnail | Sensitive; middle Snake R. endemic; few live sites |
| *Pyrgulopsis kolobensis* Taylor, 1987 | Toquerville springsnail; | May be Sensitive in ID; part of SE ID only, but found more extensively in UT |
| *Pyrgulopsis* n. sp. 7 Frest & Johannes, 1995 | Benson springsnail | Sensitive; Sublett Range endemic; 1 site |
| *Pyrgulopsis* n. sp. 8 Frest & Johannes, 1995 | Indian Hot springsnail | Sensitive; Deep Creek Mts. endemic; 1 spring complex; warm spring endemic |
| *Pyrgulopsis* n. sp. 9 Frest & Johannes, 1995 | Birch Creek springsnail | Sensitive; Lemhi-Beaverhead endemic; few sites |
| *Pyrgulopsis* n. sp. 10 Frest & Johannes, 1995 | Rock Creek springsnail | Sensitive; single valley SE ID endemic; 3 sites |
| *Pyrgulopsis* n. sp. 11 Frest & Johannes, 1995 | Pauline springsnail | Sensitive; single valley SE ID endemic; 3 sites |
| *Pyrgulopsis* n. sp. 12 Frest & Johannes, 1995 | Bannock springsnail | Sensitive; Bannock Range endemic; 3 sites |
| *Pyrgulopsis* n. sp. 13 Frest & Johannes, 1995 | Brush Creek springsnail | Sensitive; single valley SE ID endemic; 2 sites |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Pyrgulopsis* n. sp. 14 Frest & Johannes, 1995 | Teton River springsnail | Sensitive; single river endemic; 6 sites |
| *Pyrgulopsis* n. sp. 15 Frest & Johannes, 1995 | Blackfoot springsnail | Sensitive; Blackfoot Range endemic; 1 site |
| *Pyrgulopsis* n. sp. 16 Frest & Johannes, 1995 | Warm Springs springsnail | Sensitive; Snake R. Range endemic; 3 sites |
| *Pyrgulopsis* n. sp. 17 Frest & Johannes, 1995 | Wilson Flat springsnail | Sensitive; 1 nasmode, Blackfoot R. drainage endemic; 7 sites |
| *Pyrgulopsis* n. sp. 18 Frest & Johannes, 1995 | Jim Sage springsnail | Sensitive; Cotterel-Jim Sage Mts. endemic; 4 sites |
| *Pyrgulopsis pilsbryana* (Baily & Baily, 1952) | Bear Lake springsnail | Sensitive; Bear River drainage, SE ID & NE UT |
| *Amnicola* n. sp. 1 Frest & Johannes, 1993 | Washington duskysnail | 2 sites in E. Cascades & NE WA; 1 MT; Sensitive if in Idaho; |
| *Lyogyrus* n. sp. 2 Frest & Johannes, 1993 | masked duskysnail | 2 sites in E. Cascades & NE WA; could occur in Idaho, Sensitive if it does |
| *Lyogyrus* n. sp. 6 Frest & Johannes, 1997 | Snake duskysnail | SE ID, Snake drainage; Sensitive endemic; 2 sites |
| *Taylorconcha serpenticola* Hershler et al., 1994 | Bliss Rapids snail | Middle Snake mainstem and trib. endemic; Sensitive; few remaining live sites; may be composite |
| *Acroloxus coloradensis* (Henderson, 1930) | Rocky Mountain capshell | In BC and NW MT, CO; may occur in ID also; Sensitive if present |
| *Fossaria* (*F.*) *modicella* Say, 1825 | rock fossaria | Idaho generally |
| *Fossaria* (*F.*) *obrussa* Say, 1825 | golden fossaria | Idaho generally |
| *Fossaria* (*F.*) *parva* (Lea, 1841) | pygmy fossaria | Scattered over Idaho generally |
| *Fossaria* (*Bakerilymnaea*) *bulimoides* Lea, 1841 | prairie fossaria | mostly southern Idaho |
| *Fossaria* (*Bakerilymnaea*) *cockerelli* Pilsbry & Ferriss, 1906 | no common name | mostly northern Idaho |
| *Lymnaea stagnalis appressa* Say, 1821 | no common name | Sporadic over the state; especially northern and southeastern |
| *Pseudosuccinea columella* (Say, 1817) | mimic lymnaea | Introduced; sporadic over the state |
| *Radix auricularia* (Linnaeus, 1758) | big-ear radix | Introduced; sporadic over the state; abundant in impounded areas of the Snake especially |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Stagnicola* (*S.*) *apicina* (Lea, 1838) | abbreviate pondsnail | Columbia dr.: Clearwater, part of Hells Canyon, Coeur d'Alene system |
| *Stagnicola* (*S.*) *elodes* (Say, 1821) | marsh pondsnail | Sporadic over the state; may replace *Stagnicola traski* in SE Idaho |
| *Stagnicola* (*S.*) *hinkleyi* (Baker, 1906) | rustic pondsnail | Formerly ubiquitous in middle and Upper Snake and major tributaries; now should perhaps be considered Sensitive; cold water form |
| *Stagnicola* (*S.*) *idahoensis* (Henderson, 1931) | shortspire pondsnail | Little Salmon and part of lower Salmon R. only: perhaps should be considered Sensitive |
| *Stagnicola* (*S.*) *traski* (Tryon, 1863) | widelip pondsnail | Scattered over ID generally; but mostly northern |
| *Stagnicola* (*Hinkleyia*) *caperata* (Say, 1829) | wrinkled pondsnail | Sporadic over the state |
| *Stagnicola* (*Hinkleyia*) *montanensis* (Baker ,1913) | mountain marshsnail | Very rare in N. Idaho and SE Idaho; Sensitive in the State, perhaps generally |
| *Fisherola nuttalli* (Haldeman, 1841) | shortface lanx | Former candidate; rare in lower Columbia and several Idaho streams; lower Salmon, Hells Canyon, middle Snake; Sensitive |
| *Lanx* n. sp. 1 Frest & Johannes, 1995 | Banbury lanx | Sensitive; 4 sites in middle Snake R. large spring pools |
| *Physa* (*Haitia*) *natricina* Taylor, 1988 | Snake River physa | Sensitive: very rare in middle Snake; endemic |
| *Physa* (*Physa*) *megalochlamys* Taylor, 1988 | cloaked physa | Sensitive?: very rare in N. & SE Idaho, somewhat more common elsewhere |
| *Physa* (*Physa*) *skinneri* Taylor, 1954 | glass physa | Sensitive: very rare in N. & SE Idaho |
| *Physella* (*P.*) *columbiana* (Hemphill, 1890) | rotund physa | Lower Columbia R. only; reports from Idaho and Wyoming are another taxon |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Physella (P.) cooperi* (Tryon 1865) | olive physa | Over the state |
| *Physella (P.) gyrina ampullacea* (Gould, 1855) | no common name | Over the state |
| *Physella (P.) lordi* (Baird, 1863) | twisted physa | Over the state |
| *Physella (P.) propinqua propinqua* (Tryon, 1865) | Rocky Mountain physa | Over the state |
| *Physella (P.) propinqua nuttalli* (Lea, 1864) | no common name | Over the state |
| *Physella (P.) propinqua nuttalli* morph *triticea* (Lea, 1856) | no common name | Sporadic over the state |
| *Physella (P.) propinqua nuttalli* morph *venusta* (Lea, 1864) | no common name | Sporadic over the state |
| *Physella (P.) virginea* (Gould, 1847) | sunset physa | Mostly W. ID |
| *Physella* spp. | uncertain | Introduced, middle and upper Snake tributaries, including warm springs; may be *Physella cubensis* (Pfeiffer, 1839), in part |
| *Aplexa elongata* (Say, 1821) | lance aplexa | Mostly N. Idaho |
| *Aplexa elongata* morph *tryoni* (Currier,1867) | attenuate aplexa | Uncertain; N. Idaho? |
| *Gyraulus (Armiger) crista* (Linnaeus, 1758) | star gyro | Rare and scattered in the state |
| *Gyraulus (Torquis) circumstriatus* (Tryon, 1866) | disc gyro | Over the state but rather rare |
| *Gyraulus (Torquis) deflectus* (Say, 1824) | flexed gyro | Over the state; common |
| *Gyraulus (Torquis) parvus* (Say, 1817) | ash gyro | Over the state; common |
| *Biomphalaria glabrata (Say, 1818)* | bloodfluke planorb | Introduced into Snake River Plain warm springs |
| *Biomphalaria* sp. | uncertain | Introduced into Snake River Plain warm springs; may be central American spp. |
| *Helisoma (H.) anceps anceps* (Menke, 1830) | two-ridge rams-horn | Rare and scattered in ID |
| *Menetus (M.) callioglyptus* Vanatta, 1894 | button sprite | N. Idaho; common |
| *Planorbella (Pierosoma) tenuis* (Dunker, 1850) | Mexican rams-horn | Introduced into Snake R. Plain smaller streams and warm springs |
| *Planorbella (Pierosoma) subcrenatum* (Carpenter, 1857) | no common name | Mostly northern; scattered southern |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER GASTROPODS** | | |
| *Planorbella* (*Pierosoma*) *trivolvis* (Say, 1817) | marsh rams-horn | Mostly southeastern; scattered northern |
| *Planorbella* (*Seminolina*) *duryi* (Wetherby, 1879) | Seminole rams-horn | Introduced into central southern and southeastern ID warm springs |
| *Promenetus exacuous exacuous* (Say, 1821) | sharp sprite | Rare and scattered in Idaho |
| *Promenetus exacuous megas* (Dall, 1905) | prairie sprite | Likely rare in N. Idaho; Sensitive? |
| *Promenetus umbilicatellus* (Cockerell, 1887) | umbilicate sprite | Very sporadic in Idaho; mostly northern and SE cold springs |
| *Vorticifex effusa effusa* (Lea, 1856) | Artemisian rams-horn | Mostly in middle-upper Snake R.; Hells Canyon; a few large springs in SE Idaho |
| *Ferrissia californica* Rowell, 1863 | fragile ancylid | Over the state but sporadic |
| *Ferrissia rivularis* (Say, 1817) | creeping ancylid | Over the state but sporadic |
| **FRESHWATER BIVALVES (SPHAERIIDAE: FINGERNAIL CLAMS)** | | |
| *Sphaerium nitidum* Clessin, 1876 | Arctic fingernailclam | N. ID; sporadic |
| *Sphaerium occidentale* (Lewis, 1856) | Herrington fingernailclam | Rare and sporadic in N. Idaho; condition elsewhere needs study |
| *Sphaerium rhomboideum* (Say, 1822) | rhomboid fingernailclam | Sporadic at lower elevations over the state |
| *Sphaerium simile* (Say, 1816) | grooved fingernailclam | Mostly N. Idaho and Snake River Plain ; common |
| *Sphaerium striatinum* (Lamarck, 1818) | striate fingernailclam | Scattered over the state, especially southern |
| *Musculium partumeium* (Say, 1822) | swamp fingernailclam | doubtfully reported from S. Idaho; N. Idaho |
| *Musculium lacustre* (Müller, 1774) | lake fingernailclam | Over the state |
| *Musculium securis* (Prime, 1851) | pond fingernailclam | Scattered over state |
| *Musculium transversum* (Say ,1829) | long fingernailclam | Rare in N. Idaho, sporadic on Snake R. Plain |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER BIVALVES (SPHAERIIDAE: FINGERNAIL CLAMS)** | | |
| *Pisidium* (*P.*) *idahoense* Roper, 1890 | giant northern peaclam | Very rare in Idaho; primarily SE springs; perhaps should be considered Endangered in the state |
| *Pisidium* (*Cyclocalyx*) *casertanum* (Poli, 1795) | ubiquitous peaclam | Over the state |
| *Pisidium* (*Cyclocalyx*) *compressum* Prime, 1852 | ridgeback peaclam | Over the state |
| *Pisidium* (*Cyclocalyx*) *ferrugineum* Prime, 1852 | rusty peaclam | Scattered over the state |
| *Pisidium* (*Cyclocalyx*) *lilljeborgi* Clessin, 1886 | Lilljeborg peaclam | Rare at higher elevations in north and central Idaho |
| *Pisidium* (*Cyclocalyx*) *milium* Held, 1836 | quadrangular peaclam | Rare in Idaho but over the state |
| *Pisidium* (*Cyclocalyx*) *nitidum* Jenyns, 1832 | shiny peaclam | Sporadic in Idaho; mostly northern, rare in the Snake mainstem and springs |
| *Pisidium* (*Cyclocalyx*) *obtusale* (Lamarck, 1818) | obtuse peaclam | Sporadic in Idaho |
| *Pisidium* (*Cyclocalyx*) *ventricosum* Prime, 1851 | rotund peaclam | Scattered over the state |
| *Pisidium* (*Cyclocalyx*) *waldeni* Kuiper ,1975 | walden peaclam | Uncertain Idaho distribution; likely extreme northern only |
| *Pisidium* (*Cyclocalyx*) *variabile* Prime, 1852 | triangular peaclam | Over the state |
| *Pisidium* (*Neopisidium*) *conventus* Clessin, 1877 | Alpine peaclam | Sporadic at higher elevations and in deep lakes |
| *Pisidium* (*Neopisidium*) *insigne* Gabb, 1868 | tiny peaclam | Common in cold springs |
| *Pisidium* (*Neopisidium*) *punctatum* Sterki, 1895 | perforated peaclam | Rare and scattered in Idaho; so far Snake drainage only; perhaps Bear R. drainage as well |

## TABLE 2. FRESHWATER MOLLUSKS KNOWN TO OCCUR IN IDAHO (cont.).

| SCIENTIFIC NAME | COMMON NAME | RANGE |
|---|---|---|
| **FRESHWATER BIVALVES (UNIONIDA AND CORBICULIDAE : LARGER FRESHWATER MUSSELS)** | | |
| *Margaritifera falcata* (Gould 1850) | western pearlshell | Now sporadic over state; formerly ubiquitous |
| *Margaritifera* n. sp. Taylor, 1988 | Pahsimeroi pearlshell | Pahsimeroi River only; Sensitive |
| *Gonidea angulata* (Lea 1839) | western ridgemussel | Southern Idaho sporadically |
| *Anodonta californiensis* Lea 1852 | California floater | Mostly SW and northern Idaho; sporadic |
| *Anodonta kennerlyi* Lea 1860 | western floater | Dubious in western Idaho |
| *Anodonta wahlametensis* Lea, 1839 | Willamette floater | Lower Columbia R.; possiby S. ID as well |
| "*Corbicula fluminea* (Müller 1774)" auct. | Asiatic clam | Introduced: warmer waters in Snake and Bear drainage and major tributaries |
| *Corbicula* sp. | Asiatic clam | Introduced; distribution uncertain: see Hills & Patton, 1986 |

## EXPLANATION OF TABLES 1 AND 2.

Taxonomy derived largely from Turgeon et al. (1998), except for subgenera and subspecies, which are derived from the literature, with Pilsbry (1939-1948) and Burch (1989) as major sources. Sometimes taxonomy is abbreviated to fit into a category (for complete version, see individual species discussions).

Common names are derived from Turgeon et al. (1998) when available. For subspecies, names are largely from Frest & Johannes (1995, in press).

Comments apply to the Idaho range only (when the taxon ranges more widely); for complete range, see species discussions. Sensitive taxa should be regarded as high-priority taxa, often in some real danger of extinction (global priority taxa). Almost all of the Sensitive taxa discussed herein have all or a major part of their range in Idaho; all taxa defined as endemic or precinctive may be assumed to have all or nearly all of their range in a small portion of the State. A few lower Salmon River-Hells Canyon taxa, e.g., might have a site or two in Oregon or Washington.

Taxa not found on these lists may be assumed to be synonyms or do not occur in the State (barring oversights on the author's part). Note that some works may use a different taxonomy, e.g., Clarke (1981) vs. Burch (1989) on valvatids; Burch (1989) vs. Hershler (1994, 1998, 1999) on hydrobiids; Taylor (1981) vs. Burch (1989) on lymnaeids. In all cases, the best call, usually based on a current consensus, was made.

names missing here are not now accepted as being in the Idaho malacofauna or that these entities have been synonymized with other taxa. Hopefully, few or none have been simply missed.

## MOLLUSK PROVINCES AND ENDEMIC CLUSTERS

[The following discussion has been excerpted from Frest & Johannes (in press), which see for additional detailed figures and further discussion. We here reprint only absolutely necessary figures; other references are to Frest & Johannes (in press). ]

### MOLLUSK PROVINCES

#### TERRESTRIAL MOLLUSKS

**Origins and Major Divisions**

As noted previously, the origin and distribution of freshwater and of terrestrial mollusks is assumed to be a slow process generally. In particular, spread of families takes place basically at the pace of geologic time (or at least did before the advent of humanity!). The basic origin for both groups is thought to be Paleozoic; that is, dating back to at least the Gondwana Supercontinent. This becomes evident when the current and fossil distributions for any large area are compared. North American terrestrial mollusk faunas, for example, largely seem to reflect a Gondwana distribution pattern, with many families found now in North America possibly present since the Paleozoic (Solem, 1979, 1981, 1984).

Still, many characteristic land and freshwater mollusk (bivalve and snail) taxa currently living in the West Coast and ICB states have very limited geographic ranges. Part of the current freshwater snail fauna, for example, may consist of relatively recent (perhaps 65 million YBP) immigrants from Asia, or forms derived from Asian ancestors and not present elsewhere in the US. Most of North America generally is separated into two molluscan faunal realms, the Eastern and Western Divisions (Figure 1) [there is a Central American Division too, not strictly relevant here]. These have often been interpreted as terrestrial realms only, *e.g.*, Burch (1962), Burch & Pearce (1990); but the early formulations sometimes included freshwater forms (*e.g.*, Henderson, 1928, 1931). Faunas of these two areas are distinct even at the family level. For example, the NW families Helminthoglyptidae, Oreohelicidae, Bradybaenidae, and Megomphicidae do not range into the Eastern Division. All except the Bradybaenidae, which have an

extensive Asian distribution as well, are North American as well as Western precinctives. The Haplotrematidae occurs largely in the Western Division in North America (Haplotrematinae), with only one or two Eastern species: the other subfamily (Austroselenitinae) is Antillean and South American (Baker, 1941; Roth, 1991).

The question of the origin and dispersal of non-autochthonous North American mollusk families is vexed and has no satisfactory resolution in sight. Most early to mid-twentieth century malacologists, aware of the basically Asian distribution of such families as the Bradybaenidae (or of the Helicoidea in general: Miller & Naranjo-García, 1991), postulated travel to North America from Asia over a Bering land bridge, *e.g.*, Pilsbry (1894, 1939). The timing was often vague but often assumed to be no later than early Eocene and most likely earlier, perhaps Cretaceous (Pilsbry, 1939, 1948). This was quite in keeping with postulations by many contemporary biogeographers, as well as specialists in fossil and modern plants and mammals. More recently, some biogeographers have opined that transfer of biota through the Bering land bridge was relatively unimportant (*e.g.*, Melville, 1966, 1981). Another early solution to the problem of evident biotic interchange appeared when some geophysicists reported evidence that circum-Pacific, or at least western North and South American coastal and near-coastal mountain ranges, were the results of accretionary collisions. Early on, such collisions were speculated to be with the remains of a south-Pacific continent, named Pacifica (Nur & Ben-Avraham, 1977, 1982; Davis *et al.*, 1978; Kamp, 1980; Coney *et al.*, 1981), after the original suggestion by Melville (1966). The Pacifica theory was employed to explain the present-day distribution of the Helicoidea (including Bradybaenidae of current usage) by Miller & Naranjo-García, 1991).

**Accreted Terranes**

More recently, evidence has been building for formation of much of western North America from accreted terranes, that is to say, from coherent blocks of land that originated elsewhere than on the current continent. The early scenarios ascribed Asian origin to such blocks; minimally, origin offshore from the contemporary shoreline from a short distance to thousands of kilometers (Jones *et al.*, 1982; Tarduno *et al.*, 1986). Much of the evidence remains arguable; and there has been a vigorous debate as to original source and location of such accreted terranes, as well as to their biogeographic affinities. Most relevant here are probably the Klamath and Sierra Nevada terranes (*i.e.*, much of the present Klamath and northern Sierra Nevada Mountains, southwest Oregon and northwest and central California); and the Blue Mountains terranes, southeastern Washington, central western Idaho, and northeastern Oregon. In both of these areas are sizable blocks of carbonate lithologies [especially limestones, dolomites, marbles; but also other sedimentary rocks with major carbonate composition], rather rare and scattered in this

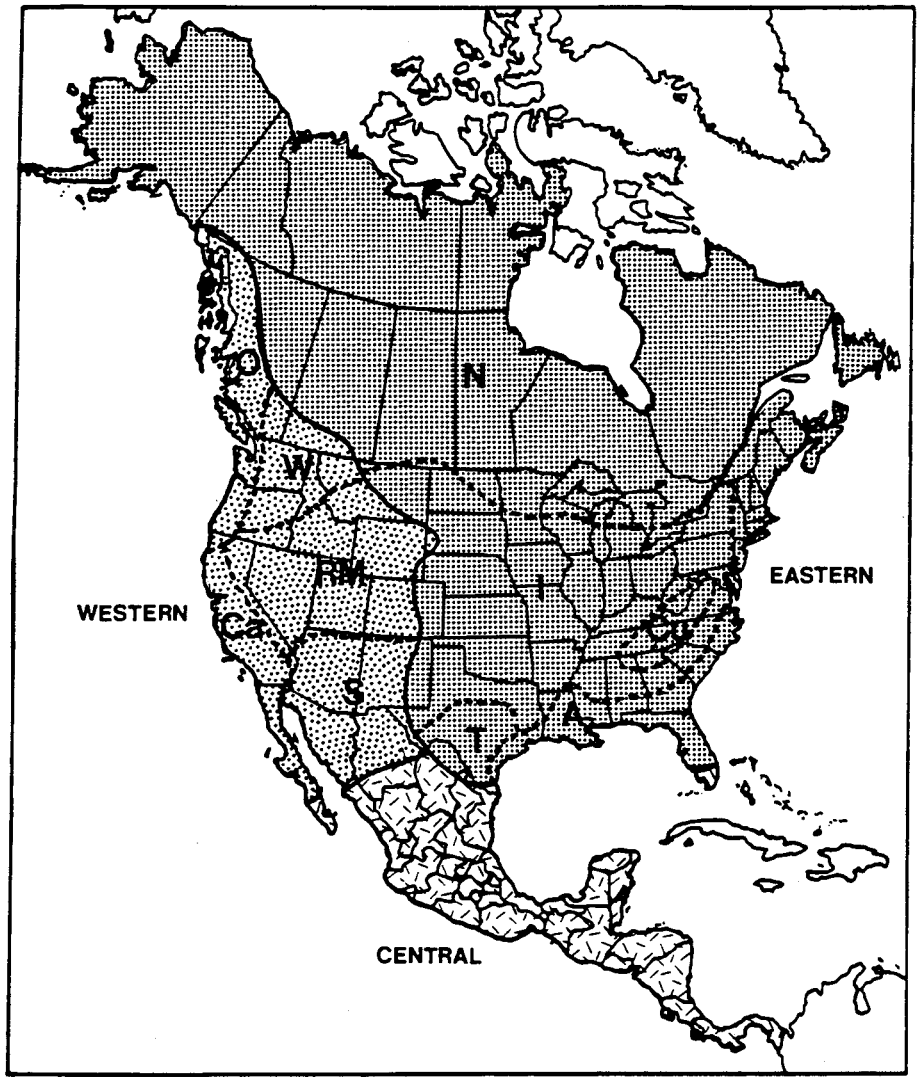


FIGURE 1. Land mollusk biogeography of North America, adapted from Henderson (1931) & Pilsbry (1948), with modifications by Bequaert & Miller (1973). The two primary Divisions are the Eastern North American Division (regular pattern) and Western North American Division (dot stipple); the Central North American Division (line stipple) presently occupies a small portion of the continent. Province abbreviations: N- Northern; I- Interior; Cu- Cumberlandian; A- Austroriparian; T- Texan; O- Oregonian; W- Washingtonian; Ca- Californian; S- Southwestern. Note that some authors apply these divisions to freshwater mollusks as well. For more detailed view of the Northwest, see FIGURE 2.

region west of the Rocky Mountain front, and presently sites of major endemic land and/or freshwater mollusk radiations. For a somewhat balanced appraisal of the Klamath Mountains and Sierra Nevada terranes, see Harwood & Miller, eds. (1990); for the Blue Mountains terranes, see Vallier & Brooks, eds. (1986).

The picture presented in the accretionary terrane literature is far from clear, consistent, or fully resolved. However, one simple version might be as follows. Around 350 MYBP, the first of a series of one or more island arc systems formed off the western Coast of North America, during the so-called Antler Orogeny. How far off the then coastline is uncertain; but one good estimate for the early-middle Paleozoic Island arc system is 1,000 m. Rocks from this system are preserved, now moved somewhat inland, in the Klamath and Sierra Nevada terranes. Biogeographic affinities of the marine fossils in these rocks suggest North American linkage. Toward the end of the Paleozoic (Permian), another island arc existed. Affinities and time and place of origin of the rocks from this one are hotly debated, with some arguing for transport from Asia across the Pacific and others arguing for offshore position, with estimates ranging from near the present shore line to 5,000 km or more. Ages and persistence are also not settled: but something on the order of 380-180 MYBP for the Antlerian arc seems most commonly touted. Docking of the so-called Intermountain Terrane(s) would have occurred in the range of about 180-140 MYBP. Most of this terrane lies in Canada: but one major segment, Quesnellia, makes up much of current northern Washington. The Blue Mountains Terrane (sometimes termed the Western Arc, Baker, and Eastern Arc terranes) would have been in place by about 100 MYBP. The Klamath and Sierra Nevada Terrane would also have been docked by this time: later tectonic activity, perhaps in the early Cretaceous (100 MYBP) would have shifted and rotated these terranes to their present position.

The last major accretionary block, the Insular Terrane (so-called because it includes Vancouver Island, the San Juan Islands, and Queen Charlotte Islands: also called Wrangellia or the Wrangellian Terrane) would have been emplaced about 100-90 MYBP. A few additional bits and pieces, sometimes grouped as the Pacific Rim terrane, were likely added during the Eocene, perhaps 30-50 MYBP. Much of the northern California Coast Range, south and southwest of the Klamath Terrane, *i.e.*, much of the Californian Province, would have been dry land for a much shorter time, ranging from perhaps 50 to as little as 20 MYBP or less. For a very readable, although perhaps oversimplified, overview of these events, and maps of the major terranes, see Alt & Hyndman (1995); see also Yorath (1990).

There are various twists and turns on the basic hypotheses, of varying credibility. Some suggest that a portion of western Idaho migrated as far northwest as the Cassiar Mountains in Northern British Columbia. Another such suggestion would have at least part of the Washington San Juan Islands originate as far south as Mexico and migrate to their present position after the Cretaceous. We will pass over these here and consider a few of the more easily conceivable results of the basic process.

Most accretionary hypotheses would involve a paleocoastline roughly parallel to the current one, or basically aligned slightly northwest-southeast, along the western boundary of present-day Idaho. The

arc island systems are presumed to lie at varying distances offshore, generally parallel also to the paleocoastline, but perhaps somewhat southwest. Movement shoreward would basically be to the northeast. There is no answer as yet as to how extensive areally the proposed island arc(s) were; nor how much, how often, and how persistent above-air manifestation would have been. Existing deposits range from near-reef to moderate-depth carbonate platform deposits to ophiolites. There are no terrestrial units known as yet; and most deposits appear to have formed at some depth. Presuming considerable and persistent terrestrial exposure, it is reasonable to assume colonization by non-marine plants and animals, including mollusks. However, sources for such colonization would still be as likely to be the nearest adjoining continent, as with the modern Japanese terrestrial fauna, *e.g.*, than Asian. Thus, some authors now prefer to distinguish parautochthonous from truly allochthonous terranes (*e.g.*, Hansen & Dusel-Bacon, 1998); and refer to most of these by the former term. Originally, Asian origin or rafting from the south and west a very considerable distance was favored by many authors. It soon be came apparent, however, that there were definite constraints on how far such terranes could have traveled (Debiche *et al.*, 1987). Still, both continents would presumably have been closer than there are now; and in any event, island arc formation would certainly facilitate island-hopping or founder events along the earlier Cenozoic Pacific Rim, as compared to the present situation.

There are, however, some obvious concomitants of terrestrial emplacement that may limit the usefulness of any variation on faunal rafting. First, most of the island arc(s) should have been subducted (and was) prior to final emplacement. Second, the nature of microplate movement is such that it is entirely conceivable that the entirety would have been underwater in the intervening oceanic trench long before docking. Finally, the degree of post-emplacement erosion and metamorphosis would seem to be considerable.

If such blocks did survive transport and emplacement with some portion of the terrestrial biota intact, one would expect them to be centers of origin for the local mollusk fauna; and, if persistent enough, possibly even to have developed their own endemic mollusk faunas, much as present Pacific islands have, often to amazing degrees and quite counter to the predictions of island biogeography theory (*e.g.*, Solem, 1959, 1978). But there is little or no indication of, say, Pacific island-style Charopidae, Punctidae, Discidae, Endodontidae, Achatinellidae, or Tornatellidae surviving or radiating into the interior. In other words, there is little evidence of the currently most typical Pacific island families colonizing the mainland. There might, however, be some. Roth (1986a), in his review of Late Cretaceous-Early Cenozoic western North American land snail occurrences, noted tantalizing hints of such occurrences. We here ignore those families with currently heavy representation in the eastern American Tropics (*e.g.*, Helicinidae; Cyclophoridae; Bulimulidae; Subulinidae). The non-analogous occurrences of these families are interesting, but the involved migration is not that far from present occurrences. However, this still leaves one tornatellinid from the Upper Cretaceous of Wyoming; a possible charopid from the Wyoming Paleocene; several camaenid occurrences (Roth, 1986a, p. 263); and a possible clausillid site in the

Wyoming Eocene. Collectively, though, these are not very strong indications; and seem about as isolated as the Lake Idaho freshwater exotics (Taylor, 1985), which mostly appear not to have persisted past the Pleistocene draining of one major Miocene-Pleistocene lake. Still, additional evidence could well strengthen the Asian as well as the tropical connection, and could argue for the reality of accreted terrane transport.

Militating against this also is the fact that, while the well-known terrane blocks may be centers of endemism, this is not often for allochthonous families. The Blue Mountains, for example, do indeed have endemics; but mostly Polygyridae and Oreohelicidae. One can write off such exotic elements in much of the Intermountain Terrane and Insular Terrane, as Plio-Pleistocene glaciation might well have displaced or extirpated such faunal elements (note that the same logic would apply to traces of Bering land bridge migrations). Only in the Klamath Terrane, and possibly the Sierra Nevada Terrane, are there indications of radiations of arguably more or less allochthonous elements. But this is largely confined to *Monadenia* and could as readily be explained as a reaction to the varied substrate and complex geology, including the unusual (west of the Rocky Mountain front) local prevalence of carbonate lithologies. Certainly, even in the Klamath Mountains, another radiation from more definitely North American and autochthonous sources, that of the polygyrids *Vespericola* and *Trilobopsis*, takes place. Dispersal of the Megomphicidae is sufficiently wide as to suggest divisional, but not coastal provincial, endemism, and a rather long local history; and sufficiently spotty as to suggest former, much more widespread occurrence.

The Eastern North American Division families not occurring in the West are generally not precinctive (*e.g.*, Philomycidae, Strobilopsidae, Helicinidae, Bulimulidae, and Sagdidae), and most have tropical to subtropical (including Central American Division) affinities. On the other hand, Eastern Zonitidae (prominent genera: *Glyphyalinia*, *Mesomphix*, *Paravitrea*, *Ventridens*, *Zonitoides*) are mostly poorly represented here (very modest *Glyphyalinia* and *Zonitoides*), with but one exception, the near-endemic *Pristiloma*. Even in such widespread North American families as the Polygyridae, very well-represented in the Eastern Division and ranging no farther south than Bermuda and Mexico, western forms are generally distinct at the generic level (*e.g.*, *Vespericola, Hochbergellus, Trilobopsis, Cryptomastix, Ashmunella vs. Daedalochila, Euchemotrema, Inflectarius, Mesodon, Patera, Praticolella, Stenotrema*, and *Triodopsis*).

In both divisions are several low-diversity genera only present in one or the other. Western examples are *Ammonitella*, *Polygyroidea*, *Noyo*, and *Hochbergellus*; Eastern examples are provided by *Hendersonia*, *Clappiella*, *Pilsbryna*, and *Vitrinizonites*. Within each Division, faunas may also differ substantially. Characteristic coastal forms are different from those of the Rocky Mountains (*e.g.*, *Monadenia vs. Oreohelix*), and south and central California coastal forms are very distinct from those of most of maritime Oregon, Washington, and British Columbia. In both cases, these differences involve not just rare taxa, but the dominant and characteristic genera in the biogeographic unit. In the Western Division, many such taxa are confined to a coastal belt that extends only from the Cascades to the Pacific, and is believed to be of comparably recent origin geologically. The Eastern Division has an equivalent in

the Gulf Coast Austroriparian Province, in which substantial representation of more or less tropical or subtropical families occurs. The East Coast does not offer any comparable situation to the West Coast, at least as regards terrestrial mollusks. There is some definite endemism to be found in East Coast unionids, however; but not involving exotic elements.

A portion of the North American fauna consists of Holarctic taxa; but it is a relatively small part. Most similarities between Old World (Palearctic) and New World (Nearctic) terrestrial mollusks are at the generic level. One conspicuous exception is the widespread tramp *Paralaoma caputspinulae*, present native in North America mainly in the coastal Pacific, from coastal Alaska (Baxter, 1987) and British Columbia to California. Another is the widespread *Cochlicopa lubrica*, found native in both the eastern and western North American Realms. Shared genera are almost entirely small forms (that is, under 1 cm maximum dimension). Conspicuous examples are in the genera *Vertigo*, *Euconulus*, *Punctum*, *Columella*, and *Discus*. In several, suggestions of shared species have been made that are not completely convincing. Much the same genera are shared between the Eastern and Western Divisions. Here, too examples of supposedly identical native species may be adduced, such as *Deroceras laeve* (probable: relations with the Eurasian species of the same name need further work, but are quite possible), *Columella edentula* (doubtful), *Discus whitneyi* (probable), *Hawaiia minuscula* (certain), *Vertigo ovata* (probable), and *Zonitoides arboreus* (certain). More common, though, are species pairs. Among larger snails, the most conspicuous example is provided by discid *Anguispira kochi kochi* (Eastern) and *Anguispira kochi occidentalis*. Also close are Eastern polygyrid *Allogona* (*Allogona*) *profunda* and Western *Allogona* (*Dysmedoma*), mostly *ptychophora ptychophora*. Still another example is *Haplotrema* (*Geomene*) *concavum* and various western haplotrematids, including other *Geomene:* but especially the widespread *Haplotrema* (*Ancomena*) *vancouverense* and *Ancotrema* (*Ancotrema*) *sportella*. Still others, with Western partners mentioned first, are *Carychium occidentale* vs. *Carychium exiguum*; *Planogyra clappi* vs. *Planogyra astericus*; *Striatura pugetensis* vs. *Striatura milium*; *Euconulus fulvus alaskensis* vs. *Euconulus fulvus fulvus*; and *Punctum randolphi* vs. *Punctum minutissimum* (there are several Eastern and Western endemics with smaller ranges in this genus).

In those instances where the genus or family is shared, the western members are often single or few, vs. an endemic Eastern swarm (Euconulidae [=Helicarionidae], Discidae (both *Discus* and *Anguispira*), Polygyridae, *Helicodiscus*, *Carychium*). A major example is the pupillid *Gastrocopta*, speciose and widespread in the Eastern Division but essentially absent native from most of the Western Provinces, with the exception of the Southwestern and very minor Californian representation. Another pupillid with a similar distribution is *Pupoides*, quite widespread in the Eastern Division but only native in the Southwestern Province in the Western Division. The Helicodiscidae are largely Eastern, with some twenty Eastern taxa and only two at all common in the West. Here again, the common Eastern form, *H. parallelus*, is only doubtfully native in the Western Division, and only in the fringe provinces (*e.g.*, Rocky Mountain, which also has westernmost representatives of several other common Eastern forms). In the Western

Division, the only prominent helicodiscids are *H. salmoneus* (Washingtonian) and *H. eigenmanni* (Southwestern). Native *Helicodiscus* does not occur in the coastal provinces (Oregonian, Klamath, Californian). In the Pupillidae, this situation arises also with *Pupilla*. The interior Western provinces (Washingtonian, Rocky Mountain, Southwestern) have at least one species common, often either *Pupilla muscorum, P. blandi,* or *P. hebes* (and note that precinctives occur elsewhere, especially in the Southwestern Province). But despite literature reports to the contrary, *Pupilla* is essentially absent from the coastal Western provinces, at least well into Alaska. This is unusual, in that both the Cascades and such ranges as the Olympics would seem to provide optimal habitat for the genus. It is present, both in eastern Asia and North America (especially Northern Province; but down the axis of the Appalachians in the Interior Province: Hubricht, 1985).

In other common genera, roughly equal numbers of taxa are involved in both Divisions (several: *Punctum*; one: *Planogyra*). For still others, most are Western (Haplotrematidae). In those in which diverse species are present in near-equal numbers, the principal taxa are often different. In *Vallonia*, the common and widespread Eastern taxa are often *V. pulchella* and *V. perspectiva* (*V. costata* and *V. excentrica* are almost as widespread), vs. Western *V. cyclophorella* and *V. gracilicosta*. In the pupillid genus *Vertigo*, there is heavy representation in each; but Eastern pupillids represent several lineages, most of which are present only as rare relicts, or not at all, in every Western Province except the Southwestern. Western *Vertigo* are generally either taxa in the *modesta* or *gouldi* group; or in the precinctive coastal provinces genus *Nearctula* (British Columbia?, Washington to Baha California Sur). Such widespread Eastern species as *V. milium* or *V. tridentata* are completely absent here. In *Columella*, the common Eastern *C. simplex* has not been reported from the west. Here, the common taxa have been termed *C. edentula* (a European taxon) and *C. alticola* (a presumed subspecies of the European *C. columella*, according to Bequaert & Miller (1973) and Turgeon et al. (1998)).

## WESTERN PROVINCES

The North American terrestrial mollusk fauna has long been recognized as showing major distributional discontinuities at a much smaller than divisional scale (Binney & Gould, 1851; Binney, 1885). Within the NSO and ICB assessment areas, there are four widely recognized land snail provinces (Henderson, 1931, Pilsbry, 1948, with modifications by Bequaert & Miller, 1973: Figures 1 & 2 herein), all in the Western North American Division. Most often, these provinces have been defined solely on terrestrial forms; but Henderson (1928, 1931) included freshwater mollusks as well, notably the genus *Juga*. As his presentations are the most complete, they will be referred to most extensively here. Modifications proposed herein and by Bequaert & Miller (1973) will be noted when appropriate. They have been necessitated by the inevitable growth of knowledge regarding the distribution of the principal

genera and taxonomic refinement of these genera. As defined by Henderson, the Rocky Mountain Province would include western Colorado, Utah, central and southwestern Montana, southeastern Idaho, and perhaps Nevada (Figure 36 herein). Most characteristic is the dominance of various species of *Oreohelix* [Oreohelicidae] and the absence of such provincial definers elsewhere as *Vespericola* and *Cryptomastix* [both Polygyridae: Henderson's *Polygyra* included these two and possibly *Trilobopsis*], the bradybaenid *Monadenia*, and haplotrematids *Haplotrema* and *Ancotrema* [Henderson's *Haplotrema*] (Washingtonian and Oregonian provinces); the polygyrid *Ashmunella*, helminthoglyptid *Sonorella*, and urocoptid *Holospira* (the Southwestern Province precinctives: see Bequaert and Miller (1973) for full discussion; and *Monadenia* and helminthoglyptids *Micrarionta* and *Helminthoglypta* (*s.l.*) as regards the Californian Province. The Washingtonian Province (northwestern Montana, northeastern Idaho, eastern [=east of the Cascade Mountains] Washington and Oregon, would be distinguished from the Rocky Mountain by the presence of *Cryptomastix*, especially *mullani* and related species, discid *Anguispira* [Henderson here meant primarily *Anguispira kochi occidentalis*], the freshwater pleurocerid *Juga* [Henderson used the then-current *Goniobasis,* valid now only for some eastern pleurocerids, mostly *Elimia, sensu* Burch, 1989], and haplotrematids; and from the Oregonian by the presence of *Oreohelix* and absence of *Monadenia*. The Oregonian Province extends from coastal Alaska and British Columbia just into extreme northern California (Figures 1 & 2 herein). To the east, this narrow province ends somewhere just east of the Cascades crest. Henderson (1931) distinguished it from the Californian by the presence of *Juga, Cryptomastix*, and *Vespericola* and by the absence of *Micrarionta* and *Helminthoglypta*, "except for some overlapping of these in the northern part of California" (Henderson, *op. cit.*, p. 183). Finally, there is a Californian Province, covering most of the California Coast, centrally into the interior as far as 250 miles; but narrowing to the north and south. Precinctives here would be a variety of *Helminthoglypta* and *Micrarionta* species and related taxa; only rare relict *Oreohelix*; and no *Cryptomastix* or *Juga*. How have these arrangements stood the test of time? Remarkably well in many cases.

**Californian and Klamath provinces**

*Helminthoglypta* has been considerably revised and expanded (see especially Roth, 1996b); but its range remains largely Californian, partly coincident with that of *Micrarionta*, despite revision of both and retooling of the Southwestern Province taxa by Bequaert & Miller (1973). Extension into southwestern Oregon is notable, however. In general, there are fewer helminthoglyptid taxa north of the San Francisco Bay region, with a tail-out of perhaps 3 or so in southwestern Oregon. *Vespericola* seems to end near the Bay region also; and *Cryptomastix* near the Oregon-California border in Oregon. The polygyrid genus *Trilobopsis*, better known than in Henderson's day but still incompletely so, is confined largely to northern California

and to southwestern Oregon. There are two rather distinct lineages, that of *T. loricata* and allied species, largely mesic and coastal, and that of *T. roperi* and relatives, semi-xeric specialists confined so far to interior northern California.

California seems to have several very sizable centers of endemism, sometimes not coinciding well with the old provincial boundaries. The Sierra Nevada Range has such endemics as the megomphicids *Ammonitella* and *Polygyroidea*, plus such distinctive lineages as the subgenus *Corynadenia* in *Monadenia* (most members of the *Monadenia mormonum* group of Pilsbry, 1939). The Shasta-Upper Sacramento valleys have such distinctive precinctives as subgenus *Shastelix* in *Monadenia* and the *T. roperi* series; there also appear to be a series of distinctive, short-ranged species in *Vespericola* (for examples, see Cordero & Miller, 1995), as well as such unusual taxa as *Vertigo dalliana*. Northern California is a greater problem now, in some regards, than in Henderson's treatment. There are a number of distinctive coastal forms, particularly in *Helminthoglypta* but also in *Vespericola* (possibly including *Hochbergellus:* Roth & Miller, 1993) and *Monadenia*. These groups continue into southwestern coastal Oregon at least as far north as the mouth of the Umpqua River. Interestingly, there is a partial freshwater parallel, for example in the genus *Pomatiopsis*. [Note: some malacologists, *e.g.* Hubricht, 1985, regard *Pomatiopsis* as a terrestrial snail]. In view of the wide deployment of pomatiopsids in fresh waters on a world-wide basis, and their close association with permanent waters, even considering such sea shoreline forms as *Cecina* and the truly amphibious and madicolous freshwater *Pomatiopsis* (see, *e.g.*, Davis, 1967, and Taylor, 1981), we prefer to group this family with the obviously obligate freshwater ones, acknowledging their predominant habitat preferences (see Davis, 1979). Note also that the high tide line pomatiopsinid *Cecina* occurs in North America from about the British Columbia border to western Oregon and northwestern California, *i.e.* along the Oregonian Province south of the glacial border and through the Klamath Province (as used herein). Extralimital records are from Manchuria and northeastern coastal Japan (Davis, 1979). The existence of such groups as the Pomatiopsidae and Succineidae, however, points out in another fashion that biogeography of the "two" nonmarine groups (freshwater and terrestrial) may reasonably be linked to some degree. One example will be discussed in some detail below.

The widespread family Pomatiopsidae, represented in North America by the single genus *Pomatiopsis*, is well-distributed, but not speciose, in the eastern US (see map 11, Hubricht, 1985, for *P. lapidaria*) but then disjunct a considerable distance, from Kansas and Nebraska to California, where it ranges from the Bay area to Tillamook County, Oregon, mostly along the coastal fog belt (Taylor, 1981; Chace, 1947; Chace & Chace, 1934, 1967; pers. obs.). Note also that *Fluminicola* (either large or small) and *Juga* (all three subgenera) are mostly absent from this region (except spottily from the Klamath to the Umpqua). In the Klamath Mountains (*s. l.*), from the Trinity Mountains in northern California to the Siskiyou Mountains in southwestern Oregon, there are several areas of considerable endemism and rich diversity (Figures 3 & 4). A few of these which are situated in the southwestern Oregon survey area will be discussed individually below but can be dealt with more summarily here. Notable are a number of species

of the bradybaenid genus *Monadenia*, the mesic-notic polygyrid genus *Vespericola;* and *Trilobopsis loricata* and related species. Also characteristic are such slug genera as *Prophysaon* and *Anadenulus*, although the former continues far north.

There is thus a considerable mixing zone between the Californian and Oregonian provinces that extends from the San Francisco Bay area to the Umpqua and south end of the Willamette Valley in Oregon. Indeed, the center of diversity for *Monadenia* and for *Vespericola* occurs in this area, particularly in the greater Klamath Mountains (including the Trinity and Siskiyou ranges). This can be informally designated the Klamath Province. Note that essentially all *Trilobopsis* occur here also, as do California sites for the relict genus *Megomphix*. As regards slugs, the genus *Hesperarion* is mostly found in the Klamath Province, although continuing into northern Oregon. There is one other possible Oregonian endemic slug genus, the poorly known *Gliabates*. For freshwater forms, also note that *Juga* (*Juga*), regarded by Henderson as absent from the Californian, has a peculiar distribution in California also largely coincident with the Californian-Oregonian mixing zone, or Klamath Province as used here (Figure 2). The suggested Klamath Province boundaries are essentially those of the physiographic Klamath Mountains Province and encompass well-recognized centers of endemism for plants (one example is *Kalmiopsis*) and amphibians as well.

Aside from *Pomatiopsis*, there are few freshwater mollusks that are confined either to the Oregonian or the portion of it distinguished here as the Klamath Province. Most typical of this region are the large hydrobiids of the currently paraphyletic lithoglyphine genus *Fluminicola*. So far, coastal lineages seem distinct from those in the Washingtonian Province (*i.e.*, largely *F. virens* and its allies in the Oregonian: *F. fuscus* and its allies in the Washingtonian). Note also that small *Fluminicola* (mostly a separate genus or genera) are absent from strictly coastal drainages and from much of the Washingtonian Province. This same pattern is exhibited by *Juga*, in which *Juga* (*Juga*) is primarily coastal (Oregonian), with some Washingtonian and Klamath Province distribution; *Oreobasis* is primarily Klamath Province (Oregonian-northern Californian) with some Washingtonian representation; and *Calibasis* is confined almost entirely to the Californian-Oregonian mixing zone, or Klamath Province. Few freshwater mollusks, with the possible exception of *Pomatiopsis* (as mentioned above) seem unique to the Oregonian (*s.l.*: mostly or wholly Klamath Province). Some exceptions are the valvatids *Valvata virens* (mixing zone ("Klamath Province") only; other reported occurrences, *e.g.*, in Burch, 1989, are erroneous) and *V. mergella* (west Cascades and coastal areas from Oregon to Alaska). One recently-discovered lineage of amnicolinids may also be entirely Oregonian, in the narrow sense, stretching from southwestern Washington south of the glacial border to Lane County, Oregon (see discussion below).

Were the Californian Province so restricted as used here, it would remain quite large and obviously very distinctive, with such large forms as *Helminthoglypta* (most lineages) and *Micrarionta*, as well as a number of other genera, very characteristic, as evident already to Binney & Gould (1851). The

content would be much as Henderson (1931) outlines it (as discussed above). Such slugs as *Anadenulus* and *Binneya* would also be characteristic, as well as such small forms as *Sterkia*.

**Oregonian Province**

The Oregonian Province as originally defined becomes much less diverse north of the Umpqua River, in both the west Cascades and Coast Range (including the Washington Olympics). Most typical are a few very widespread taxa, which extend from here to coastal Alaska (Baxter, 1987). Most notable are *Monadenia fidelis fidelis*, *Vespericola columbianus*, *Haplotrema* (*Ancomena*) *vancouverense*, and *Ancotrema* (*Ancotrema*) *sportella sportella*. Almost as extensive in distribution are *Allogona* (*Dysmedoma*) *townsendiana*, *Ancotrema* (*Ancotrema*) *hybridum*, and *Cryptomastix* (*Micranepsia*) *germana germana* and *germana vancouverinsulae*. Among the smaller taxa, *Striatura pugetensis*, *Vertigo columbiana*, *Nearctula rowelli* [*auct.*], *Euconulus fulvus alaskensis*, *Pristiloma lansingi* and *stearnsi*, *Planogyra clappi*, *Punctum randolphi*, *Paralaoma caputspinulae*, *Columella "edentula"*, and *Carychium occidentale* show much the same distribution pattern. These and a few other taxa make up a comparatively low-diversity assemblage very characteristic of much of the Northwest west of the Cascades crest. Note that in many cases, only one species is present per genus. Note also that there are relatively few centers of endemism or precinctive genera in this region (Figures 3, 4). The two most notable are the Oregon-Washington Columbia Gorge, which has endemics in *Monadenia*, *Cryptomastix*, *Vespericola*, and possibly *Anguispira*, plus endemic slugs in *Hemphillia* and *Prophysaon*, and the Olympic Peninsula, in which the endemics are largely slugs in the genera *Hemphillia* and *Prophysaon*. Very typical also of the Oregonian Province is a profusion of slugs, notably in Western endemic genera such as *Hemphillia* and *Prophysaon*. As mentioned above, the Oregonian also has the precinctive but poorly known *Gliabates* and shares *Hesperarion* with the Californian (mostly in the Klamath Province). The center of distribution for both slug genera is in western Washington, although distribution of each is much wider, with *Prophysaon* continuing to Alaska (*P. andersoni*, the precinctive *P. boreale*) and California (*P. andersoni*, *P. dubium*, the precinctive *P. fasciatum*, and undescribed taxa) and with Washingtonian representation also. Branson (1977) makes the plausible suggestion that the unusually high slug diversity here reflects the relative importance of coniferous trees and scarcity of calcareous substrate, as compared to eastern North America. In the Megomphicidae, the Californian has the precinctive *Glyptostoma*. The Oregonian and Washingtonian have *Megomphix*, with one taxon in the mixing zone [=Klamath Province] (*M. californicus*), one in the Oregonian (*M. hemphilli*), and one in the Washingtonian (*M. lutarius*).

**Washingtonian Province**

The Washingtonian Province extends east from the Cascades crest in southern British Columbia to the Idaho Panhandle and northwestern Montana, thence through much of eastern Washington and Oregon to the Cascades foothills north of Klamath Falls. In this province, *Monadenia* and *Vespericola* are present only at the western fringe, and *Cryptomastix* largely replaces *Vespericola*. Note here that the area east of the Cascades crest to the eastern Cascades foothills also may be a mixing zone. For example, *Monadenia fidelis fidelis* and *Vespericola columbianus* extend irregularly onto the eastern side of the Washington Cascades, where they may occur with *Oreohelix*. In some genera, the separation is quite clear, *e.g.,* the mesic *Microphysula cookei vs.* the semi-xeric *M. ingersolli*. Some genera or species (*e.g.*, *Polygyrella*), *Microphysula ingersolli*, and *Helicodiscus salmoneus* are provincial endemics. Examples among the slugs are especially numerous, and include the genera *Udosaryx*, *Zacoleus*, and *Magnipelta*. Also present are such precinctives as *Prophysaon humile*, *Hemphillia camelus*, and *H. danielsi*. *Oreohelix* is present but sporadic, with only a few species in two or three lineages present generally (that of *O. junii=O. strigosa*: that of *O. strigosa auct.*, not Gould, 1847). The range of the genus in this province has been extended somewhat since the time of Henderson and even since the 1970s (compare Bequaert & Miller, 1973, Figure 1 with Figure 2 of Frest & Johannes, in press). There are some Washingtonian areas, such as Hells Canyon and the Lower Salmon River drainage, Idaho, in which *Oreohelix* and *Cryptomastix* are quite speciose, with the taxa almost all very narrow endemics. Indeed, *Cryptomastix* is most diverse in two areas in northern and western Idaho (see below). *Oreohelix* has the two species groups mentioned above; plus representation from the *O. haydeni* group and two endemic lineages, that of *O. intersum* and *O. idahoensis*. In northwestern Montana, representation of the *junii* group, *haydeni* group, and *strigosa* group (*auct.*) is present, plus one largely endemic group, that of *O. amariradix*. General in distribution in the Washingtonian would be such taxa as polygyrids *Cryptomastix mullani* and *Allogona ptychophora ptychophora*, oreohelicid *Oreohelix strigosa depressus* (*s.l.*)., and discid *Anguispira kochi occidentalis*. Note also that two more or less precinctive *Allogona* taxa, *A. lombardii* and *A. ptychophora solida*, occur in this Province; but that *Allogona* is absent from the Rocky Mountain Province proper (see Figure 13 of Frest & Johannes, in press).

*Anguispira kochi occidentalis* deserves some additional comment. In Henderson's day, this species was known especially from Northwestern Montana, northern Idaho, and northeastern Washington. Since then, the taxon has been extended into the Columbia Gorge, with two reports even from western Washington (near Fife and near Chehalis (Chace & Chace, 1953): it remains uncertain if these are introduced or native colonies). It still remains characteristic of the Washingtonian and absent from the Rocky Mountain Province. As noted above, the species' present range has been interpreted as representing an original, broadly trans-Cordilleran distribution with subsequent vicariance (Roth &

Emberton, 1994). A couple of endemic discids with very small ranges, such as *Discus marmorensis*, *Anguispira nimapuna*, and *Discus brunsoni*, occur near the boundary between the Washingtonian and Rocky Mountain provinces. Perhaps the most characteristic discid in the latter is *Discus shimeki*: reports from California and Oregon for this taxon appear mistaken (B. Roth, pers. comm., 1997; pers. obs.). Some genera are common to the Oregonian and Washingtonian provinces but absent or rare elsewhere: examples include *Prophysaon*, *Hemphillia*, *Cryptomastix*, *Microphysula*, and *Pristiloma*. Note that in each of these cases, different species are present in each Province, as discussed below; and that the general distribution of each overlaps with the others considerably. A mixed Oregonian-Washingtonian distribution is also characteristic of some important precinctive Western Division freshwater genera. The hydrobiid *Pristinicola* is one example; it is essentially absent from the Great Basin and completely from the Rocky Mountain areas. Similar is the western US distribution of rissoaceans in the subfamily Amnicolinae, including *Amnicola* , *Colligyrus*, and "*Lyogyrus*". Again, Great Basin occurrences and Rocky Mountain occurrences of the subfamily are very few and rare. Almost as notable is the general absence of the hydrobiid genus *Pyrgulopsis* (s.l.), which has over 100 Great Basin species (Hershler, 1994, 1998). Washingtonian species almost entirely belong to one lineage, that of *P. intermedia* (Taylor, 1977, unpub.; pers. obs.). Other aspects of freshwater mollusk biogeography in this region are best understood as related to drainage patterns and will be discussed separately below.

**Rocky Mountain Province**

The large Rocky Mountain Province lies generally south and southeast of the Washingtonian, and includes southwestern Montana, southern Idaho, Wyoming, western Colorado, Utah, perhaps Nevada, and extreme eastern and northeastern California. It is most easily characterized by absence of many typical eastern genera (*e.g.*, eastern polygyrids) and genera common to the other Western provinces, such as *Monadenia*, *Cryptomastix*, *Pristiloma*, *Microphysula*, *Radiodiscus*, *Hemphillia*, *Udosaryx*, and *Magnipelta*. Particularly notable is the great number of species and range of morphologies in the genus *Oreohelix*. The freshwater fauna of this area is rather sparse, with many eastern (Mississippian) forms being absent, as well as such typical western US genera as *Fluminicola*, *Juga*, *Pyrgulopsis*, *Vorticifex*, and lancids (*Lanx*, *Fisherola*).

In *Oreohelix*, there are several unique species groups, as well as widespread lineages, such as that of *Oreohelix subrudis* (*s.l.*) and *Oreohelix strigosa depressa* (*s.l.*). Notable are *Oreohelix pygmaea* and related taxa (Wyoming); *O. "strigosa' berryi* and similar species (Montana, Wyoming); the *O. peripherica* species group, northeastern Utah and southeastern Idaho; the *O. yavapai mariae* group, southwestern Montana and northern Wyoming, possibly continuing into the Southwestern Province; and the eastern

Nevada *O. handi-O. jaegeri* group. Just as typical is a profusion of *O. haydeni* group taxa, with different radiations in western Utah, eastern Utah, and Colorado.

Henderson established his modern Western molluscan provinces with some explicit caveats. It should be reemphasized here that provincial boundaries are fluid at best: "[w]hatever groups of Mollusca may be chosen in prescribing boundaries of provinces in a region devoid of sharp physical barriers, there is certain to be a considerable degree of overlap. Hence the provinces must be bounded by broad zones, not by sharp lines, and no definite limits can be assigned to the broad bounding zones." (Henderson, 1931, p. 179). Second, present-day conditions only partly determine distribution: "it is highly probable that the geographic distribution of some of the most important genera was accomplished before the development of present climatic and physiographic areas" (Henderson, *op. cit.*). Finally, distributions are subject to modification by large-scale geologic events: "[t]he striking separation of the United States into two very distinct molluscan divisions suggests some profound, wide-spread cause, which may be found in the geological history of the continent. Perhaps more complete knowledge of the geological history of the several western provinces and their fauna would show that they also are the result of past geological conditions." (*op. cit.*, p. 184).

Provinces and geologic events operant in the Northwest are most intelligible, and perhaps date best, to the Late Tertiary-modern period, more specifically the last 30 million years or so. Even at present, characterization of certain areas is not straightforward. The Columbia Gorge, because of its unique position and history, manages to maintain a disparate mix of elements, many of which are endemic at the species level. Notable are taxa of *Monadenia*, *Vespericola*, *Cryptomastix*, and *Oreohelix*: these are mostly xerophiles and commonly co-occur. The mix of regionally easternmost *Vespericola* and *Monadenia* outposts with westernmost *Oreohelix* is notable. The eastern Washington and Oregon Cascades may be another such area, featuring easternmost occurrences of Oregonian Province species commingled with westernmost occurrences of Washingtonian Province taxa, along with a few unique elements. Mixing zones between the Rocky Mountain and Washingtonian provinces were alluded to above; most notable might be the upper Clearwater River drainages of northern Idaho; and parts of central western Montana.

**Distribution of Selected Taxa**

Distribution of certain typical Western genera should be noted briefly. *Oreohelix* [or more generally, the western US endemic family Oreohelicidae] is particularly characteristic of the Rocky Mountain and Washingtonian provinces in the NW. Note that most *Oreohelix* occurrences are in the eastern half of the area. Western occurrences are sporadic and belong to just a few taxa and lineages. Substantial endemism is present in the Hells Canyon area, lower Salmon River valley, southeastern Idaho,

the Wasatch Range in Utah, and in the northwestern portions of Montana. Other endemic areas, almost as large, occur in the Bighorn Mountains of Wyoming, the limestone ranges of eastern Nevada, and central western Colorado. To cite one, Frest & Johannes (1995b) noted 24 *Oreohelix* taxa in the lower Salmon River area. *Oreohelix* appears to be absent from large parts of the most arid portions of the NW (specifically, the ICB region) but continues with high diversity occurrences into the Rocky Mountains proper. The westernmost occurrences in our region are in the Columbia Gorge: but the genus does not cross the Cascades crest. Much farther to the south, there are rare Californian Province oreohelicids, with one, *Radiocentrum avalonense*, making it to the Channel Islands.

*Oreohelix* occupies a wide variety of niches, particularly in the xerophile range. Certain lineages are very widespread, notably that of *O. strigosa depressa* (as now construed, from the Canadian border to the Southwestern Province; however, Southwestern representatives may belong to a distinct species group). This group occurs widely in a range of habitats, from semi-xeric to open dry forest. Another such is the *O. subrudis* lineage, with nearly as extensive a range. The latter, as we construe it, involves mostly cold xeric taxa that occur in spruce and pine forests and open parklands, often at relatively high elevations. The *O. haydeni* species group occurs widely but sporadically, with different radiations in each area of occurrence. These taxa prefer open, quite dry habitats, including dry talus and sage scrub. Occurrences of other species groups have been noted previously. Perhaps most interesting are the semi-xeric lineages, such as the *O. peripherica* group of the Wasatch Range, Utah and Oregon, the *O. intersum* and *O. idahoensis* groups of the lower Salmon River, Idaho, and the *O. handi* species group of eastern Nevada. Some individual taxa may occur quite widely, but within a single Province, *e.g.*, the Washingtonian *Oreohelix junii* and so-called *Oreohelix strigosa strigosa*. More frequent are taxa restricted to a single mountain range and highly endemic taxa limited to single valleys or mountainsides. Examples are legion and come from all of the major species groups. For one well-known set, see Frest & Johannes (1995b). So far, it would appear that the narrow endemics are more likely to occur at lower elevations in rather dry habitats. However, unusual taxa such as *O. elrodi* and *O. alpina* belie simple generalizations.

The polygyrid *Cryptomastix* occurs mostly in the eastern ICB (Washingtonian Province) and in the Oregonian Province. In the latter, only 2-3 species are present, all quite different from the Washingtonian taxa. The subgenus *Micranepsia* is restricted to the Oregonian. Only one species of *Cryptomastix s.s.*, *C.* (*C.*) *devia*, occurs in the Oregonian, with a distribution from Puget Sound to the northern Willamette Valley and west to the Coast. Areas of high endemicity are in Hells Canyon, the lower Salmon River valley, and the Clearwater River drainage, with one subgenus, *Bupiogona*, limited to the Hells Canyon-lower Salmon River area. The genus does not occur in the far south ICB or in the Rocky Mountain Province. Diversity is low in interior Washington and Oregon and in northwestern Montana; and limited largely to one species group, that of *Cryptomastix mullani*. The genus appears to be absent from large areas in both Oregon and Washington, as well as from Rocky Mountain Province Montana. There are few fossil records for this taxon,

outside of Late Pleistocene-Holocene sites. Oregonian species prefer mesic habitats; in the interior provinces, taxa range from mesic to quite xeric-tolerant.

Another polygyrid, *Trilobopsis*, occurs mostly in northern California but is absent from the core Californian Province. There are currently two species groups, that of *T. loricata*, which occurs mostly in mesic forests (including redwoods) from San Francisco Bay to southwestern Oregon (southern Oregonian-northern Californian provinces). The second species group, that of *T. roperi*, occurs largely in interior northern California, along the Trinity, upper Sacramento, and Shasta river drainages. These species are rather tolerant of dry conditions and commonly live in rocky areas or taluses. The rather limited occurrence of these taxa is notable, in that considerable areas of central and southern California would seem to provide adequate habitat for them currently. There are few fossil records for this taxon, outside of Late Pleistocene-Holocene sites.

The most widely distributed polygyrid genus in the Northwest is *Vespericola*, which ranges into Alaska. This genus is currently under revision. At present, there are about 16 described and perhaps the same number of undescribed species. A closely related genus, *Hochbergellus*, has also been described somewhat recently (Roth & Miller, 1993). *Vespericola s. l.* is predominantly Oregonian. Peculiarities of the distribution are the concentration of taxa in the Klamath geologic Province, *i.e.*, southwestern Oregon and northwestern California, in which there appear to be at least four distinct species clusters, and the widespread occurrence of just one taxon, *V. columbianus*, which occurs from southern Oregon to southern Alaska (Roth & Miller, 1993). Outside of Late Pleistocene-Holocene sites, there are few fossil records for this taxon. Roth (1986a) lists one possibility, from the Oligocene or Miocene of central Oregon (John Day Formation). Most species are mesic-notic; but one semi-xeric tolerant lineage is known.

One last polygyrid genus, *Allogona*, deserves some comment. We recognize four taxa currently, three of which occur in the Western Province, in the precinctive subgenus *Dysmedoma*. Location here is not province-wide: the genus is absent from the Californian, Southwestern, and Rocky Mountain provinces. In the Oregonian, the mesic-notic forest *A.* (*Dysmedoma*) *townsendiana* is quite widespread and often abundant from the North Cascades, Washington to the vicinity of Portland, Oregon. *A.* (*Dysmedoma*) *ptychophora ptychophora* is quite widespread over the mesic and semi-xeric area of the Washingtonian, being perhaps the most common and widespread large taxon in the Province. In the more mesic portions of the Clearwater and lower Salmon river drainages, of Idaho, there is a rather local taxon, *lombardii*, which occupies very similar habitats to Oregonian *A.* (*Dysmedoma*) *townsendiana*. A semi-xeric and xeric taxon, *A.* (*Dysmedoma*) *ptychophora solida*, occupies portions of the lower Snake and lower Salmon river drainages. Like several other Western taxa, the genus is absent from Rocky Mountain Province portions of Montana, Wyoming, and Idaho, even though there is a quite common and widespread Eastern Division Interior Province taxon, *A.* (*A.*) *profunda* (see map in Hubricht, 1985). This is another genus with relatively few fossil sites, outside of Late Pleistocene-Holocene Midwest ones.

The endemic family Megomphicidae has an oddly spotty distribution which has long been regarded as relictual (Pilsbry, 1940). Five genera are widely recognized: *Megomphix*, *Glyptostoma*, *Polygyrella*, *Ammonitella*, and *Polygyroidea* [note: Barry Roth, pers. comm., 1998, and 1997, prefers to rank *Glyptostoma* as a subgenus of *Megomphix*]. In our area, only two genera have anything approaching wide distribution: the largely Oregonian mesic-notic *Megomphix*, with two more or less separate but sizable areas of occurrence, one for *M. californicus* and another for *M. hemphilli*; and mesic to semi-xeric *Polygyrella polygyrella*, with a fairly extensive range in parts of northern Idaho and northwestern Montana (Washingtonian Province). Interestingly, both genera also have outlying sites in the Washingtonian Blue Mountains of northeastern Oregon and southeastern Washington (taxa are *Polygyrella polygyrella* and semi-xeric *Megomphix lutarius*). Otherwise, the family is represented in the NW only in the Sierra Nevada region by a few sites with *Ammonitella yatesi* or *Polygyroidea harfordiana*, also somewhat dry conditions-tolerant taxa.

Interestingly, this family has a fair fossil record, with some sites known from Upper Cretaceous to Miocene strata from Alberta, Montana, Wyoming, and Oregon (for critical appraisal, see Roth, 1986). Note that some sites are definitely extralimital to the modern distribution.

The endemic North American Helminthoglyptidae is very well represented in the Californian and adjacent Southwestern Province as recognized by Bequaert & Miller, 1973, with approximately 150 described Californian forms (Roth, 1997). The genera and subgenera recognized by Roth (1996b) are as follows: *Sonorelix* (*Mohavelix*, *Sonorelix*); *Micrarionta* (*Micrarionta*, *Nicolenea*), *Chamaerarionta*, *Herpeteros*, *Xerarionta* (*Xerarionta*, *Plesarionta*), *Cahuillus*, *Eremarionta* (*Eremarionta*, *Eremariontoides*), *Noyo*, *Rothelix*, *Helminthoglypta* (*Helminthoglypta*, *Coyote*, and *Charodotes*). Note that in our area (Figure 15, Frest & Johannes, in press) there are relatively few forms, most in *Helminthoglypta* (*Helminthoglypta*) and one in *Noyo*. Certain groupings, such as the *H. arrosa* and *H. nickiniana* series of Pilsbry (1939), as amended by Roth (1996b), seem to characterize the northern portion of the family's range. Helminthoglyptids also help to distinguish the Southwestern Province, notably the numerous taxa in *Sonorella*. Most helminthoglyptids prefer semi-xeric or xeric conditions. Common habitats are rock taluses and beach areas. Relatively few are forest taxa, although some redwood forest-inhabiting taxa are known. Many seem to favor forest openings with such plants as manzanita and oak dominant.

There are a fair number of fossil occurrences noted for helminthoglyptids, some of which are extralimital (Roth, 1986a). The range is Upper Cretaceous on, with sites in Alberta, Wyoming, Oregon, Texas, and New Mexico.

The bradybaenid taxon *Monadenia* is one of the most characteristic NW forms. As presently understood (*e.g.*, Roth & Pressley, 1986), there are three subgenera: *Monadenia*, *Shastelix*, and *Corynadenia*. One of these, *Monadenia s.s.*, is particularly widespread. *Monadenia* (*s.s.*) ranges from southern Alaska to the San Francisco Bay area, with most distributional area in the Oregonian Province. There are about 15 well-characterized described and undescribed taxa; but nearly all occur in extreme

southwestern Oregon and adjacent northwestern California (Klamath Province). Over most of the Oregonian, the only taxon found is *Monadenia* (*M.*) *fidelis fidelis*, the exceptions being in well-known relict areas, such as the Columbia Gorge and Upper Klamath Lake region. Perhaps as many as 15 additional well-characterized forms are presently known in the remaining two subgenera. *Shastelix* and *Corynadenia* have a rather restricted range in parts of northern California. The restriction of many *Corynadenia* to a very narrow strip of the Sierra Nevada is particularly notable. Many of the forms in these subgenera occupy rather open, semi-xeric habitats, in contrast to the mesic Douglas fir or redwood forests preferred by most *Monadenia* (*M.*). Even in this subgenus, however, there are some more or less drought-tolerant forms, as those in the Deschutes River drainage (Oregon) or the other endemic areas cited previously. Over all, the general absence of *Monadenia*, particularly *Monadenia s.s.*, from what may be termed core Californian areas is striking.

There are surprisingly few fossil records for the genus, particularly outside of its area of current occurrence. One possibility (Roth, 1986a) involves three taxa from the Oligocene or Miocene John Day Formation of Oregon. Both *Monadenia* and possibly *Shastelix* are represented.

Smaller shelled forms, despite their large contribution to total mollusk diversity, are not as yet well-known in this region and will not be dealt with in great detail. Perhaps most interesting is the distribution of the nearly precinctive western US (there is one Japanese species) *Pristiloma*. This genus occurs in all of the Western Division Provinces with the exception of the Southwestern and Rocky Mountain. There are several subgenera: we recognize *Ogaridiscus* here as separate; and perhaps this treatment will eventually be extended to others. The genus, with about 14 taxa, occupies the whole of the Oregonian Province and continues coastally into the Californian, with a separate group of species in the latter. The more widespread Oregonian forms are the wet woods *P. lansingi and P. stearnsi*, the coastal *P. nicholsoni*, and the upland *P. arcticum* and *P. wascoense*. Note that there are some endemic or restricted forms, such as *P. pilsbryi*, *P. nicholsoni*, *P. orotis*, and *P. shepardae*. In the Washingtonian Province, perhaps most characteristic are *P. idahoensis* and *P. chersinella*; *P. wascoense,* a form of *P. arcticum* and *Ogaridiscus subrupicola* may also be typical (or may have been formerly). *Ogaridiscus* represents a lineage well-adapted for dry areas. Note that seemingly widespread taxa, such as *arcticum* and *wascoense*, are high-elevation forms occurring only sporadically in each Province. Also of interest is the seeming absence from parts of the dry eastern Interior of Washington and Oregon, a feature also notable for other genera, such as *Cryptomastix* and *Allogona*. This is partly an artifact of collecting; but probably represents as well a consequence of the open and dry climate typical of this region since the rise of the Cascades, an effect hence generally likely to have become more pronounced from the Miocene to the Recent, possibly absenting glacial episodes. *Pristiloma* has a very limited fossil record, outside of Late Pleistocene-Holocene fissure and cave deposits.

The slug genus *Hemphillia* is typical of both the Washingtonian and Oregonian provinces. Its distribution pattern is similar to that of *Cryptomastix* or *Pristiloma* but more exaggerated, with major lobes

into the mountainous regions of both provinces. As with both shelled taxa, species are very different in the west Cascades and Olympics (Oregonian), *versus* Idaho and Montana (Washingtonian), although here higher diversity is in the Oregonian Province, not the Washingtonian. Only two taxa, the Oregonian *H. dromedarius* and the Washingtonian *H. camelus*, are particularly well-distributed. There are two species groups in this genus, a long-tailed series with prominent visceral hump (*H. dromedarius*, *H. malonei*, *H. camelus*, *H. danielsi*, and related taxa) and a short-tailed group with less prominent visceral hump (*H. glandulosa*, *H. burringtoni*, *H. pantherina*, and related taxa). The short-tailed group is largely or entirely confined to the Oregonian Province: the long-tailed forms occur as well in the Washingtonian. These are overwhelmingly slugs of mesic and notic forest habitats and are particularly characteristic of mature forests. Some taxa appear to be narrowly endemic.

Also very characteristic of the Western Division provinces, particularly of the NW, is the slug genus *Prophysaon*. Like *Pristiloma*, this genus has close relations to Japanese or other Asian forms, but not to eastern US forms. The distribution is from the northern Californian mixing zone [or Klamath Province] through the Oregonian and part of the Washingtonian, again avoiding the dry, hot, non-mountainous portions of interior Washington and Oregon. There is one Californian described endemic, *P. fasciatum*. Several rare taxa, described and undescribed, are Oregonian precinctives with restricted ranges, mostly in southwestern Washington and northwestern Oregon, although one, *P. boreale*, is Alaskan. Most widespread are three species that range from at least Washington to California. *P. andersoni* is most common and ubiquitous, ranging to Alaska and California and reportedly into Idaho. *P. foliolatum* and *P. vanattae* are fairly common in western Washington and Oregon and coastal British Columbia. The uncommon *P. dubium* ranges from central Washington to northern California. Also rather rare is *P. coeruleum*, which occurs from central Washington to southern Oregon. The Washingtonian Province has its own widespread form, *P. humile*; and *P. andersoni* has also been reported from this Province. Most taxa prefer mesic to notic situations: but *andersoni*, *humile*, and *foliolatum* are comparatively tolerant, while *dubium*, *coeruleum*, and some undescribed forms seem less so. Some forms may be narrow precinctives.

Perhaps most typical of the Washingtonian Province, as noted above, is the presence of several precinctive slug genera: *Zacoleus*, *Udosaryx*, and *Magnipelta*. All three seem rather scattered in occurrence presently, perhaps because they seem to be associated with uncut or mature forests. All three genera are monospecific, although two subspecies are recognized in *Udosaryx lyrata*.

Many genera, perhaps half or more of the total, are distributed more or less uniformly in the NW (excepting the drier portions of the interior and some other special cases discussed before). These tend to be the more cosmopolitan types, such as *Discus*, *Punctum*, *Vallonia* (although rare in the Oregonian), *Columella*, *Vertigo*, *Euconulus*, *Cochlicopa*, *Nesovitrea*, and *Zonitoides*, with representation in Europe and northern Asia as well. A significant number of taxa have the more sporadic distribution suggestive of relict or precinctive status. Assessment area examples of the former include *Polygyrella* and *Megomphix*:

of the latter, *Oreohelix* and *Monadenia*: see **SPECIES DISCUSSIONS** (both herein and in Frest & Johannes, 1995a, in press) for details.

## FRESHWATER MOLLUSKS

NW freshwater mollusk distribution in many ways parallels that of land snails, as perhaps first realized implicitly by Henderson (1928, 1931); considering the obvious differences in habitat, any parallelism is remarkable. That observed results from the response of aquatic systems to the same major landscape features and tectonic events, particularly those dating from the Late Cenozoic. Similarly, land snail dissemination tends to be along stream corridors, and is often limited by factors similar to those controlling distribution of stenotopic freshwater mollusks. Like land snails, freshwater mollusks at higher taxonomic levels are mostly conservative and relatively sessile, so that major changes, such as evolution of new families or introduction of a family to a new continent, are comparatively rare. The latest possible examples of such change (and their reality is still a subject of debate by malacologists) are the bizarre freshwater mollusk faunas of some of the ICB Plio-Pleistocene lakes, notably Lake Idaho and Lake Thatcher. The most speciose examples occupy an arc from northeastern California and northwestern Nevada across the Oregon Interior Basins to southeastern Idaho, extreme western Wyoming, and extreme northeastern Utah (but, notably, not Great Basin Lake Lahontan or Lake Bonneville). Good reviews of this subject and of the place of mollusks in the evolution of freshwater ecosystems as a whole are found in Taylor (1985, 1988a, c) and Gray (1988).

Much of North America west of the Rocky Mountains is rather new terrain, geologically speaking, having been added to the continent as a result of large-scale tectonics, including volcanism, mountain range formation, and microplate accretion during the last 20-100 million years. As a consequence, drainage evolution has been considerable, much more extensive than that of the core continent in the same period. There have been two systematic attempts to define North American freshwater mollusk provinces: Hannibal (1912) and Henderson (1931). Hannibal's idiosyncratic style and bizarre taxonomy makes his version difficult to comprehend, let alone apply seriously. Henderson's (1931) approach basically yielded provinces very similar to those for terrestrial forms; but was based on the presence or absence of very few genera, notably *Juga*. A modification of both of these arrangements, emphasizing present drainage basins, is used by Burch (1989). Refinement of freshwater mussel provinces in the eastern US has been considerable (Van der Schalie & Van der Schalie, 1950; Johnson, 1970, 1972; Taylor, 1988a). As with terrestrial forms, recent increases in the number of western freshwater taxa suggest the need for revision here, too. Nevertheless, the main outlines remain sound; and we developed some of the parallels between terrestrial and freshwater provinces above. We will here

approach the subject of western freshwater molluscan provinces from a slightly different angle, emphasizing drainage development and history. This was in essence the approach utilized by Taylor (1985, 1988a, c) previously and refined somewhat here based on the substantial increase in western freshwater described taxa and biogeographic data over the last fifteen years. It is interesting to note at the outset, however, that the Pacific freshwater mussel Province and the large Western US area with no freshwater mussels coincide rather precisely with the Western terrestrial Mollusk Division (note especially the Mississippian-Pacific and area of no freshwater mussels border).

At present, the major drainage systems in the Pacific Coast states are those of the Columbia Basin (Columbia, Willamette, Deschutes, John Day, Clearwater, Salmon, and Snake drainages), the Interior Great Basin (Lahontan, Oregon Interior, and Bonneville), and two regions of Pacific Coast drainage interrupted by the Columbia River (Burch, 1989, fig. 20). During the late Cenozoic, several large-scale geologic processes have formed and rearranged these drainages. The rise of the Cascade, Coast, and Great Basin ranges considerably modified both drainage and climates. The most extensive mountain-building episodes took place in the Eocene, Oligocene, and Miocene. Volcanism has been widespread since that same period [in the ICB proper, particularly during the Miocene and Pliocene], and continues today, most notably in the NSO assessment area. Some is associated with the formation and development of the major mountain ranges. Other events are connected with the Pliocene-Recent migration of a diapire or hot spot across the Washington-Oregon border through southern Idaho to its present location at Yellowstone National Park. The extensive Columbia Basin and Snake River Plain basalts [*e.g.*, Columbia Group; Grande Ronde Group] are at least partly related to this process. Plio-Pleistocene glaciation and the related Bonneville and Missoula Floods (both *ca.* 15,000 YBP: see Jarrett & Malde, 1987 and Baker & Barker, 1985: for a good non-technical overview, see Alt & Hyndman, 1995) have also affected freshwater mollusk distribution. Formation of the Snake River Plain, an event still not completely elucidated tectonically, is another major cause of drainage modification.

There is a considerable literature regarding the relationship between drainage and geologic history, particularly for the Columbia Basin, Sacramento River drainage system, and Great Basin. The best single work as regards effects on mollusks is Taylor (1985); some particularly salient points will be summarized here. In the Miocene (approximately 20 million years ago (MYBP), much of the West was included in a few large and integrated drainages. The Columbia system was much smaller, and the Lahontan Basin was a coherent, outward-draining [Pacific tributary] system. During the late Miocene and Pliocene, the rise of the Coast and Great Basin ranges disrupted the Lahontan system, converting it into many internally-draining small basins. Drainage of areas peripheral to the Great Basin was modified considerably during the late Pliocene and Pleistocene. Much territory, including Hells Canyon and the upper Snake, was added to the Columbia system at this time. The Snake proper [current middle and upper Snake drainage] had formerly been a Pacific-draining stream, with connections to the Klamath and Sacramento systems.

Many of the large pluvial lakes formed earlier in the late Miocene or early Pliocene either contracted or went dry periodically during the later Pliocene and during Pleistocene interglacials (such as the present). Only a few of these large lakes were incorporated into coastal systems (the Upper Klamath Basin is the best example); but Great Basin forms entered into the Klamath and Sacramento systems *via* such routes. In turn, California forms which had earlier penetrated into the Snake system were stranded in various isolated drainages. Many Pliocene lakes had considerable endemic faunas; only remnants of these persist today (such as some of the listed Idaho cold water species: Frest & Johannes, 1992a). In northern Washington, extreme northern Idaho, and northern and northwestern Montana, late Pleistocene glacial advance removed or relocated much of the freshwater fauna. Areas affected at that time today have limited Western faunas; but short-lived drainage connections during the most extensive Pleistocene glaciation allowed a few Mississippi forms to reach the West Coast. Note that one would hardly expect, then, the present freshwater mollusk provincial arrangement to extend intact to these areas. Terrestrial mollusks seem to have been better able to re-extend their distributions north after the last glacial recession, *ca.* 10,000 YBP, than have even some of the most characteristic Western freshwater forms. Some examples of mollusk groups with wide Western distributions and also typically Western endemics, entirely or mostly south of the Wisconsinan glacial margin include the following: the large *Fluminicola* species; the "lithoglyphinid" *Pristinicola*; the pleurocerid *Juga* (*Juga*); the lymnaeoidean Lancidae; and the planorbid *Vorticifex.*

In other cases, Miocene-Pleistocene tectonics and glaciation seems to have induced bicoastal speciation as classic vicariance events in genera present across the continent. The western representatives of the rissooidean subfamily Amnicolinae provide examples (Frest & Johannes, 1998). The only western *Amnicola* is an undescribed taxon related to the eastern US *Amnicola limosa.* Western *Lyogyrus*-like amnicolinids appear to belong to a different genus or genera. All seem to have paucispiral operculae and the penial lobe originates close to the base, not at midpoint as in well-known eastern forms. There appear to be significant internal anatomical differences as well, at least in the best-studied forms (Hershler, 1999). Similarly, Western and Eastern *Pyrgulopsis* appear to fall into separate groupings (Hershler, 1994). Among pulmonates, the ubiquitous *Planorbella* (*Pierosoma*) *subcrenatum* occupies a wide range of habitats similar to those utilized by *Helisoma* (*Helisoma*) *trivolvis* in the East: the latter does not occur native in the West, except possibly in the areas equivalent to the Rocky Mountain Province. *Menetus callioglyptus* (=*M. opercularis* of many authors: see Taylor, 1981) is as widespread and eurytopic here as *Promenetus exacuous exacuous* is in the East; the latter is very sporadic and rare here. A number of quite widespread Eastern forms are similarly present in the Western Division but very rare: *Helisoma* (*Helisoma*) *anceps, Promenetus exacuous exacuous, Gyraulus* (*Armiger*) *crista, and Planorbula campestris* are examples (for the latter, see Taylor, 1966).

**Major Drainages**

Consideration of the freshwater malacofauna on a drainage basis, as done by Burch (1989, p. 77, fig. 20) may provide an instructive contrast. Our region would be assigned to portions of the Pacific Drainage, Columbia River Drainage, Interior Basin Drainage, Colorado River Drainage, and Mississippi River drainage The Oregonian, Californian, and Klamath Province (if allowed separate status) would be Pacific; much of the Washingtonian would be Columbia River; the Southwest would be in the Interior and Colorado River; the eastern northern Rocky Mountain would be Mississippi River; and the southern Washingtonian and western Rocky Mountain would be in the Interior Basin and Columbia River drainages. Such an analytical breakdown has some features to recommend it, notably as regards southern Idaho and the Oregon Interior basins; but also tends to fragment some faunally or geologically established units, such as the Great Basin or the distribution of *Pyrgulopsis*. Discussion of the malacofauna of some of the major drainages indicates additional problems with this scheme.

Some general considerations apply to nearly all. The freshwater mollusk fauna of each major contemporary drainage system is often composite. There is a strong continent- or world-wide component, as well as a generalized western North American element. Certain characteristic western genera, such as *Fluminicola* and *Juga*, have parallels with eastern forms (*e.g.*, *Elimia* and *Somatogyrus*); but their nearest relatives are as likely to be extralimital (*e.g.*, the Chinese *Namrutua,* the Chinese and Korean *Hua*, and Japanese *Semisulcospira* for *Juga*; the South American *Potamolithus* or the European *Lithoglyphus* for *Fluminicola*). For example, despite a strong overall resemblance, DNA evidence (Holznagel & Lydeard, 1996; Holznagel, 1997) indicates strong separation of the western and eastern pleurocerid swarms, so much so that the relationship of western and eastern species could be regarded with equal plausibility as requiring *Juga* to be ancestral to all eastern forms or both deriving from an unknown earlier ancestor. Note that the Russian literature has used *Juga* for numerous eastern Asian (Siberian, *e.g.*) pleurocerids since the 1970s: one example is Bogatov & Zatravkin (1990). In other cases, the differences in "recent" geologic history between western and eastern North America are reflected in different species swarms in the same genera, *e.g. Pyrgulopsis* (Hershler, 1994) and *Tryonia*: *Amnicola*; Eastern *Lyogyrus* and Western "*Lyogyrus* " (possibly = *Colligyrus*).

Sphaeriids as elsewhere mostly have continent-wide or even hemisphere-wide distributions; but a couple of species are western endemics, notably *Pisidium* (*C.*) *ultramontanum* and the Modoc peaclam (Taylor & Bright, 1987). Note that Taylor (1988c) regards a rare Russian species as a sister taxon to *P. ultramontanum*. The western unionacean fauna is small compared to nearly 300 eastern species; none are common to the two regions. Notable is the prevalence of two taxa, the margaritiferid *Margaritifera falcata*, and the odd endemic *Gonidea* (with one species, *G. angulata*). Some unionid specialists (Smith, 1999, pers comm.) think that *Margaritifera falcata* is most closely related to Asian forms, not the Holarctic

*Margaritifera margaritifera*, present widely in the eastern and central US and in Europe, or other eastern US forms. Taylor (1988c) regards a Korean unionid as either in the same genus as the otherwise western US endemic *Gonidea* or very closely related. The western US Anodonta species, which make up the rest of the western US large freshwater bivalve fauna, remain relatively poorly studied; but few or none seem closely related to the eastern US anodontids. The characteristic eastern North American genera *Pyganodon* and *Utterbackia*, for example, are absent from the West.

The more stable areas generally have core faunas, including some endemics; speciation has been rampant in the interior basins; and major portions of each large system have been added from other systems. Such areas have distinctive faunas, often with sister species in the drainage of origin and in the captured segment. Regions with complex geologic history and varied substrate are most likely to have endemics, especially in springs and spring-influenced habitats. In general, elements most exotic to North America and/or most characteristic of the NW tend to occur coastally or west of the Cascades, while Great Basin and eastern forms tend to be found east of the Cascades. Local biotic interpenetration and mixing are extensive, however, just as with terrestrial mollusks.

**Pacific Drainage**

The Pacific Drainage, mostly small, high-gradient permanent streams with small drainage basins, is situated similarly to the coastal land snail provinces (Washingtonian, Oregonian, Klamath, and Californian). Such coastal areas are somewhat distinctive as regards freshwater mollusks. The Oregonian area has abundant *Pristinicola* south of the Wisconsinan glacial margin; there is also a coastal "*Lyogyrus*" lineage that seems morphologically distinctive, also beginning only south of the latest Pleistocene glacial margin, but perhaps ending before the Klamath Province. Also typical of the northern (Oregonian and Klamath) parts of the Pacific Drainage are *Juga* (*Juga*) species. This area, much of the range of the NSO, is further characterized by the presence of large species of the hydrobiid (Lithoglyphinae, *s.s.*) paraphyletic genus *Fluminicola*, particularly species related to *Fluminicola virens* (see Hershler & Frest (1996) for redescription of this taxon). The northern part of the Pacific Drainage also generally lacks lancids and *Vorticifex*, again south of the Wisconsinan margin. Note that division of this area by the Columbia seems to have had little effect on freshwater mollusk distribution, even though the Columbia River fauna itself is somewhat unusual (see below).

North of the Wisconsinan glacial margin, Pacific drainage freshwater faunas take on a different character. *Pristinicola* is lost somewhere above the Chehalis River drainage on the Olympic Peninsula, Washington. *Pristinicola*, *Juga* and *Fluminicola* do not occur except sporadically north of the Nisqually River, Puget Sound, Washington. On the Olympic Peninsula, both *Juga* and *Fluminicola* become quite

rare and sporadic north of the Chehalis River drainage, although perhaps continuing almost to the Strait of Juan de Fuca. Note that we discount reports of *Juga* from Vancouver Island, British Columbia, along with such assertions as that *Juga plicifera* (Lea, 1838) " is the only species of *Juga* living in the State of Washington" (Clarke, 1981, p. 86). Most typical here are such forms as *Valvata mergella*, *Menetus callioglyptus* (according to Taylor, 1981: =*Menetus cooperi* Baker, 1945 in Clarke, 1981; *Menetus opercularis* of many other authors) and *Sphaerium patella*. There are some parallels here with the sparse Oregonian regions as defined by land snails.

The mixing zone [or Klamath Province] and northern part of the Californian, that is, the Cascades crest and west from southwestern Oregon to the San Francisco Bay area, including the Central Valley, is also somewhat distinctive. This is the region to which most *Oreobasis* and *Calibasis* are confined (Figures 30 & 31): named examples are *Juga* (*O.*) *chacei* and *Juga* (*O.*) *orickensis; Juga* (*Calibasis*) *acutifilosa* and *Juga* (*Calibasis*) *occata*. Note that the pleurocerids may be both coastal and found in the Interior (Central Valley), as with *Oreobasis*, or just Interior (*Calibasis*). Interior Klamath Province faunas also include lancids of the genus *Lanx* (with one exception, the Banbury lanx, a relict middle Snake drainage species which will be discussed later). Note further that the aberrant planorbid genus *Vorticifex* is also mostly absent from the coastal parts of this region but present in the Interior. *Vorticifex* in California occurs mostly in the Central Valley streams and peripheral Great Basin. In coastal and near coastal northwestern California and southwestern Oregon are found the only Western US occurrences of the rissoacean family Pomatiopsidae (subfamily Pomatiopsinae: ?three taxa, found also in eastern North America, South America (Brazil), Australia, Africa (South Africa), and Asia (China, Manchuria, Japan, Philippines). Davis (1979), in his masterful review of the family, postulates Asian (Gondwana) origin for the Pomatiopsinae, followed by migration to Western North America and thence to eastern North America after the Gondwanaland breakup. This is in possible contrast to the situation with the Hydrobiidae; but detailed information on hydrobiid subgroup origination and migration is not yet available. Note, however, the contrast between eastern and central North American and western North American hydrobiids emphasized here. Davis, in a series of papers and monographs dating from 1979 [Davis, 1979] to 1998 [Davis et al., 1998], has spent a considerable amount of time and effort in clarifying the relationships between the Hydrobiidae and Pomatiopsidae and in constructing an elegant historical biogeographic hypothesis regarding the latter's origin, distribution, and migrations with respect to major tectonic events. In scope and thoroughness, his work on this family is essentially without parallel among freshwater groups. At this point, the distinctness of the Pomatiopsidae and Hydrobiidae is clear; and most recent results support their biogeographic distinctness as well (Davis et al., 1998).

The rivers in the mixing zone [=Klamath Province] area differ somewhat from those north (again excepting the Columbia). Three are fairly extensive systems, in contrast to the short and steep-gradient Oregon and Washington rivers to the north. The Umpqua and Rogue have drainage areas several times the area of most coastal streams and penetrate nearly through the Cascades. The next drainage south,

the Klamath, is even larger in area and penetrates the Cascades into the Oregon Interior Basin and peripheral California great Basin. From the California border south to the San Francisco Bay region, the Interior is drained by one extensive system, the Sacramento-San Joaquin, which exits coastally, like the Rogue and Umpqua. Note that penetration of the whole of the Cascades is very exceptional for coastal streams, with only three US examples: the Columbia; the southwestern Oregon-California Rogue-Umpqua-and Klamath systems; and the Sacramento-San Joaquin.

Extensive recent collection indicates that the freshwater mollusk faunas of these three mostly Oregon rivers and the Sacramento (at least the upper portion, from Shasta Lake northward) are closely interrelated (for Upper Klamath see Frest & Johannes, 1996b; for Upper Sacramento, Frest & Johannes, 1995d, 1997a; for Rogue and Umpqua, Frest & Johannes, 1998a, in press, and herein). Shared are *Lanx* species (*Lanx alta* in the Rogue and Klamath; *L. klamathensis* and *L. alta* in the Upper Klamath; *L. subrotundata* in the Umpqua; *L. patelloides* in the Sacramento) and a prevalence of numerous small *Fluminicola* species, interestingly only found east of the Coast Range. Some large *Fluminicola* of the Upper Klamath seem fairly distinctive anatomically; but others are very similar to Sacramento or Umpqua forms. Only the Rogue, anomalously for either a Western coastal stream or river of its size, lacks a large *Fluminicola* species. The Klamath, Rogue, and Umpqua share two pleurocerid species, *Juga* (*J.*) *silicula shastaensis* and *Juga* (*Oreobasis*) *nigrina* (*s.l.*): the distribution of *Calibasis* is almost entirely in the Sacramento, Klamath, and Rogue systems. Further, the Sacramento and Klamath share some Great Basin elements, such as *Pisidium ultramontanum*, the Modoc peaclam (Taylor & Bright, 1987), and *Helisoma* (*Carinifex*) *newberryi*. Further, *Pyrgulopsis* is present but rare in both drainages, as is "*Lyogyrus*". There are some differences. *Pristinicola* has so far not been found in the Sacramento system, although extending into the drainages of the other three. The Upper Klamath drainage has very few pleurocerids, in contrast to the lower and middle Klamath, as well as the Sacramento, Rogue, and Umpqua. The Rogue and the Umpqua so far lack *Pyrgulopsis* and "*Lyogyrus*".

Even within these drainages, mollusk distribution is somewhat peculiar but shares some strange parallels. Small *Fluminicola* species occur in all. However, these are found only in the middle and upper Klamath and the upper portions of the Rogue and Umpqua. Likewise, such forms are confined to the upper parts of the Sacramento system only. In effect, the small forms are absent from coastal portions of each drainage and occur only on the southeastern side of the Klamath area. So far, small forms are largely confined to springs in these drainages, with two exceptions. The first is that each system seems to have a single amniphile headwaters form, although different species for each river. The second is that, so far, there are few headwaters spring forms in the Umpqua system, as compared to the other three river drainages.

The lack of a large amniphile *Fluminicola* in the Rogue has been commented upon previously, as has the apparent sharing in the Oregon systems of *Juga* (*Juga*) *silicula shastaensis*. Distribution of *Oreobasis* in them is somewhat analogous to that of small *Fluminicola*. Forms of *Oreobasis* are, however,

relatively common to much of southwestern Oregon and northwestern California. These seem to include coastal forms related to *Juga* (*O.*) *chacei* and *Juga* (*O.*) *orickensis*; and another group more closely allied with *Juga* (*O.*) *nigrina*. In the lower (coastal) portions of the Oregon systems, *i.e.*, those in the Coast Range, forms like *chacei* or *orickensis* seem to predominate in springs and spring-fed creeks. The interior areas, especially in such streams as the Rogue, seem to lack *Oreobasis*, the same niche being occupied by species of *Juga* (*Juga*). But towards the Cascades, at about the same point that small *Fluminicola* species begin to occur, these are replaced by spring-dwelling *Oreobasis* species again, this time more closely resembling *Juga* (*O.*) *nigrina*. The Sacramento system, whose coastal portions lie at the extreme edge of the range of *Juga*, seem to show a similar pattern, with the coastal forms more or less like *chacei* and *orickensis* and the headwaters forms *nigrina* or related species. The reasons for the seeming lack of *Oreobasis* in portions of the core Klamath and Siskiyou mountains is not clear; but it is interesting that the same mountains also seem to form a barrier for the westward expansion of the small *Fluminicola* species. This is so even though suitable habitat is continuous in all of the Oregon systems from coastal areas into the Cascades and mixing zone areas.

The coastal distribution of Pomatiopsidae (s.l.) in the western US is similarly peculiar and not fully explainable by reference to ecology. Taylor (1981) felt that western US species of *Pomatiopsis* were confined strictly to the coastal fog belt. This well reflected what was known of their distribution to that point. However, Davis (1967) had previously noted two very different habitats for California *Pomatiopsis* in the San Francisco area. He found *P. californica* living "on shallow mud banks and marshy seepages leading into shallow streams" in a near sea level habitat along Bolinas Bay (op. cit., p. 134). In contrast, he found *P. binneyi* high on Mt. Tamalpais, "in dense shade"...."either in the path of trickling water or sprayed by water steaming down steep canyon slopes" (op. cit.). He opined that *P. binneyi* "is different from the other species in the genus on the basis of shell and habitat". We recently (1998) have extended the range of *Pomatiopsis* (s.l.) some 200 miles north in Oregon to Tillamook County. Two forms were collected, one of which resembles *P. californica* and the other *P. binneyi*. So far, the *P. californica* form seems more or less strictly confined to areas within less than a mile to 20 miles of the Pacific Coast, i.e. on the west side of the Coast Range. We found it in low gradient, muddy, sites relatively near to the Coast, much as described by Davis.

This is not so true, however, of the *P. binneyi* form, which has been noted 10-20 miles inland, far removed from coastal fog influence. Our sites tend to be edges of medium to high gradient, very small spring runs, seepages, or similar areas close to small waterfalls. Similar habitat, however, exists from the Coast to Crater Lake and is particularly prevalent in the Klamath and Siskiyou mountains proper, from which, however, the genus (s.l.) has yet to be noted. Interestingly, sites for Pomatiopsidae so far are confined to the strictly coastal, smaller streams; none have been noted for the Rogue, Klamath, or Umpqua drainages; and certainly none in the upper Sacramento system.

Cursory examination of newly collected material confirms Davis' (1967) earlier observations. *P. californica* seems closely similar in external morphology, both of shell and body, to *P. lapidaria*; and is rather close to that taxon in habitat. *P. binneyi* superficially resembles the problematic genus *Pristinicola* in shell and external body morphology; and it occurs in a similar habitat. It is rather tempting to suggest possible relationship; but even so, it should be noted that the range of *P. binneyi* and *P. californica*, even as now construed, remain largely in the coastal areas of the Klamath Province, while that of *Pristinicola* is much more extensive. Recent careful searching of the many sites at which "*Lyogyrus*" and *Pristinicola hemphilli* have now been recorded (roughly 200 sites each collected since 1988) should have revealed many more for Pomatiopsidae if these were more extensively distributed. And the seeming absence from the larger, more problematic drainages of the region (the Klamath, Umpqua, and Rogue) and confinement to small drainages would seem significant.

Below the Klamath River mouth, most California coastal streams are again small. Central and southern California have freshwater mollusk faunas with few strict precinctives. Both *Tryonia* and *Pyrgulopsis* occur here, with low diversity, both coastal and inland. Many strongly Western precinctives, such as *Juga*, *Fluminicola*, western amnicolines, *Pristinicola*, Lancidae, and *Vorticifex* are completely absent or barely present on the northern margin of the area. Arizona and New Mexico freshwater faunas are similar, with common endemic *Pyrgulopsis* and lesser diversity of *Tryonia*; but none of the other genera (note that most of these were unknown to Bequaert & Miller, 1973: see Hershler & Landeye, 1988 and Taylor, 1988 for descriptions) and a rather cosmopolitan fauna overall. However, there is little obvious relation between lower coastal and interior California *Pyrgulopsis* and *Tryonia* and those of eastern California, Arizona, and New Mexico. Over all, it is clear that the Pacific drainages make little sense as a single unit; but considerable if considered as three or four distinct units, with boundaries more or less coincident with terrestrial units in the same area.

**Columbia River Drainage**

The Columbia River Drainage, analogous to much of the Washingtonian land mollusk Province, is characterized by large *Fluminicola* also, in this instance related to *Fluminicola fuscus* (most of area; larger streams only) and *F. coloradensis* (southeastern part of area: small streams and springs) (again, see Hershler & Frest, *op. cit.*). *Fluminicola virens* occurs only in the lower Columbia. The Columbia River Drainage is also the range of the endemic monospecific lymnoidean genus *Fisherola*. *Juga* is rare here, occurring in western and southwestern peripheral regions (more analogous to the Oregonian Province) only. Other hydrobiids (amnicolines *Amnicola, Colligyrus,* and "*Lyogyrus*" are also almost completely confined to the Columbia drainage and parts of the Pacific drainage. Hydrobiids generally are rather rare

and spotty in distribution in the Columbia system, except for *Fluminicola*. Another exception is the precinctive *Pristinicola*, common in the Pacific and Columbia drainages (Hershler *et al.*, 1994) and found elsewhere only peripherally.

Some of the difficulties and advantages of the drainage approach may best be illustrated with a large system, such as the Columbia. As presently constituted, the Columbia encompasses well over half of the NW assessment area. It bisects the Oregonian Province (northern Pacific Drainage) in the Cascade Range (Columbia Gorge) and then arcs broadly through much of interior Washington before exiting the US into southern British Columbia. Major tributaries, such as the Kootenai and Clark Fork, drain northwestern Montana; the Coeur d'Alene and Clearwater, northern and central Idaho; the Snake, southeastern Washington, southern Idaho, and western Wyoming; the Deschutes and John Day, much of northern Oregon; the Willamette, much of Oregon between the Cascades and Coast Range; the Chehalis, much of southwestern Washington.

As one might expect in a system of this size, there is quite a bit of faunal turnover from mouth to headwaters. This system, like many of the world's larger rivers, may be divided into a headwaters, rhithron section, and lower potamon section (Illies, 1974: see more complete discussion below). Some of the observed faunal changes in this system are diversity gradients explained by such physical parameters. For example, freshwater mollusk diversity increases near the mouth of the Columbia. This is largely because a suite of about half a dozen species, some large-river specialists, are added. Examples are *Vorticifex neritoides*, *Physella columbiana*, a disjunct undescribed *Pyrgulopsis* species, *Fluminicola virens*, and *Anodonta wahlametensis*. Closer examination, however, indicates that only the first two are likely potamon specialists. *Anodonta wahlametensis* may inhabit much smaller streams and is disjunct to the lower Columbia for historical reasons (discussed below). *Fluminicola virens* is also present in much of the mainstem Willamette system and part of the lower Chehalis system, both tributary to the Columbia. Still, this effect cannot be entirely discounted. Another possible example is provided by the Willamette, the largest lower Columbia tributary. Two species of *Fluminicola*, *F. nuttalliana* and an undescribed form now likely extinct, were found only in the Willamette below Willamette Falls, *i.e.*, near the mouth. One or both of these may also have continued to the mouth of the Columbia. Looked at on a broader scale, however, such general diversity patterns tend to break down; and their explanatory power for generic and higher taxonomic biogeography is quite limited. *Fluminicola virens* and related species, for example, seem to be limited largely to the lower Columbia and some large and small tributaries. Above the middle Columbia, one finds mostly *Fluminicola fuscus* (present also to the mouth) and related taxa. These are all the *Fluminicola*, for example, in the Snake system and in most other eastern peripheral streams, such as the Spokane and Kootenai. But *fuscus*-like species are absent from the Clearwater system, where a disjunct *virens*-like taxon occurs; and *Fluminicola* is also absent from most northwest Montana streams. Similar local discontinuities of distribution occur with the lancid *Fisherola*, absent from the Clearwater and upper Snake: and with *Vorticifex*, present in the lower Columbia and sporadic in lower tributaries such as the

Willamette and Deschutes; but also present in the lower and middle Snake. Moreover, there are local foci of endemism in unpredicted locales, such as the small streams in the Columbia Gorge (*Juga* (*J.*) and *Juga* (*O.*) spp., "*Lyogyrus*"; but not *Fluminicola*, which is virtually absent except in the mainstem Columbia). Another such is the lower reaches of the Deschutes (*Juga* (*J.*) *hemphilli maupinensis* and *Juga* (*Oreobasis*) *bulbosa* are the described amniphile forms), with three or more endemic pleurocerids, none of which occurs in the Columbia itself (*Juga* (*J.*) *plicifera bulimoides* at this point). It is interesting that local endemic clusters of land snail species occur in the same drainages in both cases; but that the rich endemic terrestrial faunas of the Hells Canyon-lower Salmon River area are only poorly matched by endemic freshwater taxa (see below). One freshwater endemic cluster, that of the middle Snake River, is not known to be matched at all by terrestrial endemism, perhaps because very few land snails of any sort are found in this region, which was subject to recent volcanism and until recently (?Late Pliocene-Early Pleistocene: latest Blancan-earliest Irvingtonian: Repenning *et al.*, 1995) was partly or wholly submerged by Lake Idaho. Similarly, the distribution of *Pristinicola* and of Western Amnicolinae does not seem to conform to drainage boundaries, even though major parts of the range of each are in the Columbia River Drainage. *Vorticifex* is another example, with the genus present in the Columbia system just in certain major tributaries, such as the Willamette, part of the Snake, and the Deschutes, plus the mainstem river below Grand Coulee, while absent from much seemingly suitable habitat elsewhere in the system. Even more striking is the ubiquity of *Juga* in the Columbia and its tributaries and springs, large and small, below the John Day River (Figure 29) but not above. Based on habitat, there is no reason why the genus could not cover the whole system. Another such example concerns small *Fluminicola*, absent from the entire system except for the middle Deschutes River drainage, Oregon. Similar distribution anomalies occur elsewhere in the NW, such as the absence of small *Fluminicola* species in the lower Klamath, lower Rogue, or lower Umpqua rivers, but rather ubiquitous occurrence above either the middle or lower part of each drainage: but they are most obvious in this large system.

**Northwest Mississippi River drainage**

Little of the eastern peripheral area (northwest Mississippi River Drainage: somewhat similar in location and extent to the northern part of the Rocky Mountain Province) has *Fluminicola* at all. This same area largely lacks *Juga* species or such western hydrobiids as *Pyrgulopsis*; most other hydrobiid genera, Western or Eastern, are also rather sparse here. Lancids are totally absent also, while present in northwestern Montana, possibly along with *Fluminicola fuscus* (certainly present historically in adjacent Canada). Much of this area does have a reduced Mississippian fauna, with such familiar Eastern taxa as

*Promenetus exacuous exacuous*, *Planorbula armigera*, *Stagnicola elodes*, *Helisoma anceps*, *Valvata tricarinata*, and *V. sincera* relatively frequent.

The contrast between the Mississippian portion of western Montana and the Columbia portion is analogous to that between the Washingtonian and Rocky Mountain provinces as regards terrestrials. It is not as evident in the other portions of the Rocky Mountain province, as these are included in the Columbia system (mostly Upper Snake drainage in Idaho; Green River-Colorado River) drainage in Wyoming and Colorado; and Great Basin and Colorado River drainages in Nevada and Utah. Much of this area, however (Colorado; Wyoming east of the Green River drainage) also lacks Western genera.

**Interior Drainage**

The Interior Drainage Province, situated similarly to the southern portion of the Washingtonian Province, includes most of northeastern California, northwestern Nevada, Utah, southern Oregon (Interior Basin), southern Idaho, and extreme western Wyoming. Endemic clusters are most notable in the family Hydrobiidae (small *Fluminicola* species peripherally) and *Pyrgulopsis*; the pleurocerid genus *Juga* (here, the subgenera *Oreobasis* and *Calibasis* only) is very local or completely absent. *Pyrgulopsis* species clusters here are not closely related to those of the central Great Basin; and the distribution of the genus *Tryonia* lies mostly to the south of the ICB. Amnicolines, essentially "*Lyogyrus*" (possibly = *Colligyrus*), are scattered around this region's periphery, mostly outside the presently Interior drainages. The same situation applies to the genera *Vorticifex* and *Pristinicola*, also strictly peripheral and almost entirely absent here.

The core Interior Drainage Province is the Lahontan and Bonneville portions of the Great Basin, including most of Nevada, some of eastern and northeastern California, Utah, and a portion of southeastern Idaho. This area is readily characterized by a profusion of *Pyrgulopsis* species, most of which were described only recently (Hershler, 1994, 1998). A few taxa have extensive distributions in either the Lahontan area (*Pyrgulopsis gibba*: see Hershler, 1998, Figure 54), the Bonneville Basin and southeastern Idaho (*P. kolobensis*: Hershler, *op. cit.*), or southeastern Idaho (*P. pilsbryana*: Hershler, *op. cit.*, Figure 55). There are also scattered occurrences of *Tryonia*, especially *T. protea*, particularly in the southern half of the Great Basin (Hershler & Landeye, 1988; Hershler, 1999). Also typical in is region are a number of areally limited endemic clusters of several *Pyrgulopsis* species in small, often isolated internally draining basins, such as those in Owens Valley (Nevada-California), Ash Meadows (Nevada), the Pahranagat Valley (Nevada), Steptoe Valley (Nevada), Duckwater Valley (Nevada), and the Sevier Valley (Utah). Over one hundred *Pyrgulopsis* species have now been described from the Great Basin: see Hershler & Sada (1987); Hershler (1989, 1994, 1998) for details and references. For map of *Pyrgulopsis*

distribution in our area, see Figure 24 in Frest & Johannes, in press. At the same time, other hydrobiid genera are rare or lacking in the Great Basin. There are at best peripheral occurrences of Amnicolinae and *Pristinicola*, for example. Amnicolinids and a few better represented larger *Fluminicola* (related to or identical with *F. coloradensis*: Hershler, 1999) are present in northeastern Utah and vicinity; and small *Fluminicola*, mostly *F. turbiniformis,* occur in the peripheral Great Basin in an arc extending from Lake Tahoe north to Goose Lake and Lake Abert east to the Catlow Valley in Oregon (see map in Hershler, 1999: for known distribution of all small *Fluminicola*, see Frest & Johannes, in press). Summarizing then, it seems clear that present drainages do not make a very secure fit with freshwater mollusk distributions; but, oddly, that terrestrial mollusk provinces manage a rather better one, though still far from perfect.

Eastern and Midwest readers will be quite used to the long and successful tradition of mollusk biogeography and past drainage interpretation using the diverse and originally ubiquitous freshwater mussels. This is unfortunately not practical here. NW freshwater mussels are few (perhaps 9 species); all differ from eastern species, and all have now lost considerable portions of their range. One monospecific genus, *Gonidea*, is endemic. Perhaps two-thirds of western North America comprises a single province, the Pacific. The remaining part is in an area with no large freshwater mussels. The Pacific Province has boundaries resembling those of the terrestrial mollusk Western American Division, and includes all of both the NSO and ICB. The smaller fingernail clams or sphaeriids are more varied (perhaps 20 species in the ICB); but most are relatively cosmopolitan, and there is little indication of endemism, except for two important taxa, both restricted to the Great Basin periphery: *Pisidium ultramontanum* and *Pisidium* n. sp. (see Taylor & Bright, 1987 for distribution map). Both taxa are very rare and show the fishhook pattern of distribution (Taylor, 1966a, 1985; Taylor & Bright, 1987), discussed in detail above.

As with the terrestrial forms, a few ICB and NSO areas have strongly composite faunas, difficult to assign to a single province. Notable is the Columbia Gorge. This region combines endemic *Juga* (*Juga*) with endemic *Juga* (*Oreobasis*) species; has *Fluminicola* only rarely (and, unlike other areas, these do not occur in springs); lacks crenophile *Pyrgulopsis*; but has endemic "*Lyogyrus*" (possibly= *Colligyrus*). The nearby lower Columbia River and Deschutes River have strange faunas, combining coastal elements with endemics seemingly derived from Great Basin peripheral drainages. Another such area is the Upper Klamath Lake drainage, which has many surviving Great Basin elements, plus its own endemic swarm of hydrobiids (mostly small *Fluminicola*, but including large *Fluminicola*, "*Lyogyrus*", and *Pyrgulopsis* species: Frest & Johannes, 1996b, 1998a). This region also has unusual planorbid diversity, notably in *Helisoma* (*Carinifex*) and *Vorticifex*; and two rare sphaeriid species. It is worth noting that most of the biogeographically "difficult" freshwater areas present similar problems with their terrestrial mollusk faunas.

**Distribution of Selected Taxa**

Ranges of some of the more significant ICB and Pacific Coast freshwater genera are discussed individually here. Freshwater species confined to single or a few streams or springs are common in western North America. Many small and some large taxa are restricted to particular streams or to particular springs or spring sets (nasmodes) in the ICB assessment area. Pleurocerids (all in the genus *Juga*: for subgenus distribution, see Frest & Johannes, in press) are very important in the coastal province streams (NSO assessment area) but only peripherally invade the ICB; occurrences there are notable but not common or typical. Pleurocerids are anomalously rare in the present Upper Klamath Lake drainage but diverse in the Columbia Gorge and in the Oregon Deschutes River. They are essentially absent from most of Interior Oregon, eastern Washington, southern and central California, Idaho, and Montana.

At present, three subgenera, distinguished primarily on the basis of early whorl sculpture (Taylor, 1966) are distinguished. The nominate subgenus, with strongly and consistently plicate early post-nepionic whorls, occurs primarily in Oregonian Province coastal streams, mostly south of the Late Pleistocene glacial margin. The subgenus extends a short way into northwestern California, mostly in the Klamath drainage. *Juga* (*Juga*) extends over the Cascade crest only in a few areas, notably the Columbia Gorge, Deschutes River (Oregon), and Upper Klamath Lake drainage. Most taxa are stream forms. The distribution of the second subgenus, *Oreobasis*, with smooth or irregularly and faintly plicate whorls, differs considerably. Most coastal taxa occur in the Klamath mountains area. Interior taxa occur in northern California and, disjunct some distance, in the Columbia Gorge-Deschutes River-John Day River drainages, mostly in north-central Oregon. Most taxa here are spring forms. Most peculiar of all is the modern distribution of *Calibasis*, whose early whorls have strong revolving lirae. *Calibasis* occurs mostly in interior northern California: the two best-known taxa have peculiar habitats, with one favoring large streams and the other large springs. There is a limited fossil record for these taxa, one feature of which is the apparent Miocene occurrence of *Calibasis* as far north as interior Washington (Taylor, 1985). In western Washington, the Eocene Cowlitz Formation appears to contain representatives of both *Juga* (*Juga*) and *Juga* (*Oreobasis*) [pers. obs.; see also Taylor, 1966a and Weaver, 1942]. The relatively common and widespread Rocky Mountain fossil pleurocerids, especially those reported from Cretaceous-Eocene rocks (Henderson, 1935), require reevaluation of their relationships. The may have little to do with modern Western taxa. Taylor (1988a, unpub.) reports a variety of pleurocerid and pleurocerid-like taxa from Lake Idaho, including subfamilies no longer occur native in North America.

The family Lancidae, restricted solely to a small part of western North America, is generally coastal in distribution and occurs mostly in a few streams in southwestern Oregon-northwestern California. Additionally, one genus and species (*Fisherola nuttalli*) occurs in the Columbia Basin, and a relict Endangered *Lanx* species is found at three sites in the Idaho middle Snake drainage. These large limpets

occur now mostly in larger streams and in limnocrenes. One living taxon, *L. klamathensis*, inhabits spring-fed lakes; but this habitat seem to have been quite widespread in the Miocene-Pliocene pluvial lakes of the area. These aberrant lymnaeoid taxa have no gills, ctenidia, lungs, or equivalent structures, but respire through a heavily vascularized mantle (Baker, 1925). The group is an old one, with fossils dating back to the Cretaceous and fairly numerous Miocene-Pliocene sites in Nevada, Oregon, and Idaho. The lancid *Lanx* is present on the southwestern periphery of the ICB and in the middle Snake River; elsewhere in the Columbia Basin, *Fisherola* is the only lancid present.

An odd feature of the Western freshwater fauna is the prevalence of limpet-like forms, possibly related to the former widespread occurrence of swift, oligotrophic streams with very coarse substrate. Adoption of the limpet shape does not occur elsewhere in the Lymnaeoidea, but quite characterizes the long-lived, precinctive Lancidae. The Western Division has the familiar Ancylidae, the prevalent Eastern limpets. It also has a widespread, limpet-like planorbid, *Vorticifex*, with a similar shape to *Neoplanorbis*. Approaches to the same shape occur in *Fluminicola*, with undescribed taxa very close in appearance to *Lepyrium*. In the fossil record are fairly widespread occurrences of the endemic Payettiidae and of Neritidae with limpet- or *Crepidula*-like shape. Also present is a limpet-shaped physid, *Hannibalina* (Hanna, 1963). So far, no limpet-like pleurocerids have turned up; but one undescribed limpet-shaped hydrobiid is known.

Distribution of the Hydrobiidae is particularly interesting. The highly speciose and typically endemic genus *Pyrgulopsis* is mostly present in the southern part of the ICB, with the exception of one disjunct area along the lower Columbia River. *Pyrgulopsis* species are notably sparse west of the Cascades crest and in the Coast Ranges, with the partial exception of California (Hershler, 1995a). Great Basin peripheral forms, *e.g.* those in Interior Oregon and southeastern Idaho, appear to often belong to different lineages than those of the core Great Basin. While about half belong to a common species group, the remainder seem to make up well-differentiated species clusters (Hershler, 1998) characteristic of each area. This sort of distribution has been noted in *Pyrgulopsis* elsewhere, *e.g.* in northeastern California, Ash Meadows, Death Valley, etc. (Hershler, 1994 and references therein: undifferentiated endemic area in Figure 4 herein). While most *Pyrgulopsis* species are western, there is a small eastern group, well separated morphologically as well as geographically from their western congeners (Hershler, 1994).

The Amnicolinae deserve special attention. Some recent treatments (*e.g.*, Ponder, 1988; Ponder & Warén, 1988; Hershler & Thompson, 1988; Thompson & Hershler, 1991; Hershler, 1999) regard this group as a subfamily in the Hydrobiidae while others (*e.g.*, Davis & Kang, 1995) regard it as a full family. For the moment, we retain it as a hydrobiid subfamily, while recognizing its possible distance from other hydrobiids. Well-known Amnicolinae occur in Europe, the Russian Federation, and North America, often deployed almost as successfully in stygean habitats as epigean. Stygobiont forms are known from eastern North America (Hershler & Holsinger, 1990) but so far not from the West (Frest & Johannes, 1998a). Until

recently, there were only a few amnicolonid sites in western North America. As of this writing, there are at least 170 (Frest & Johannes, 1998b), with representation in Washington, Oregon, Idaho, Montana, Wyoming, Utah, and California.

*"Lyogyrus"* occurrence is mostly north of that of *Pyrgulopsis*, although overlap occurs, particularly in eastern Wyoming, northern Utah, south central Oregon, and southeastern Idaho, producing unusually diverse faunas in the last two areas. Distribution of western *"Lyogyrus"* is patchy, unlike the situation in the eastern US. Most western forms were discovered relatively recently; but at least some of the distributional discontinuity appears to be real: for example, that in southwestern and south central Idaho (approximately Lake Idaho margins). Similarly, absence of "*Lyogyrus*" from all except the largest, low elevation springs and streams in the Upper Klamath Lake and Upper Sacramento-Pit drainage seems well established (Frest & Johannes ,1996b, 1997a, 1998a). Middle to high elevation springs elsewhere, such as in southeastern Idaho and the Blue Mountains, northeastern Oregon, commonly have taxa either resembling or identical to *Colligyrus greggi*.

In general, Western "*Lyogyrus*" appear quite different from eastern forms, and may well constitute one or more separate genera or subgenera when better studied (see, *e.g.*, Hershler, 1999 on *Colligyrus*). Most distinctive are the species clusters in the Upper Klamath Lake drainage, Oregon; Upper Sacramento-Pit drainage, California; and Bear River-upper Snake River drainage, southern Idaho. Northern taxa bear stronger resemblance to eastern forms in morphology and habitat, but also seem distinct at the species level or better. All Western "*Lyogyrus*" examined so far have paucispiral opercula, in contrast to the multispiral ones characteristic of the better-known Eastern forms; and also have the penial lobe originating near the base, rather than the midpoint, of the penial filament. In view of this and evident internal anatomical differences, we use *Lyogyrus* in quotes for Western taxa. Apparent absence of *"Lyogyrus"* from large areas of the ICB appears to be real, and is evident in the fossil record in some regions as well. These small taxa have a poor fossil record, in part simply because the smaller forms from some areas are largely unstudied.

Biogeography of the characteristic western lithoglyphine genus *Fluminicola* (*s.l.*) is somewhat problematic at present, as detailed revision is just now getting under way (Hershler & Frest, 1996). It is likely that this paraphyletic genus will be split into several subgenera or genera when taxonomic work is complete: and just which anatomical group the type species [likely extinct] belonged to is far from certain. Large species of *Fluminicola* (*s.l.*) occur throughout much of the Pacific coastal drainage region and the ICB, with two important exceptions. This genus historically was very rare in northwestern Montana; and indeed now may well be extinct there. Large *Fluminicola* also has not been found in much of the Oregon Interior Basins region. Where the genus occurs, there is considerable differentiation at the species and perhaps higher levels. Coastal large forms, often with male genitalia and shell morphology like those of *F. virens*, are mostly distinct from those of interior Washington and Idaho. Those in the upper Snake drainage, Green River (Wyoming), and northeastern Bonneville Basin (mostly allied to *F. coloradensis*)

may also be distinct from species occurring lower in the Snake and Columbia and their larger tributaries (*F. fuscus* and related taxa). Large *Fluminicola* species in the lower Columbia and lower Willamette rivers (Washington-Oregon) may well also represent a separate group (*F. nuttalliana*; another undescribed possibly extinct species). Some of those in the Upper Klamath Lake drainage, with alate penes, almost certainly do. There is a fairly rich fossil record for larger *Fluminicola* species (*contra* Nuttall, 1990, p. 214), ranging from the Paleocene to the Recent (reviewed in Hershler & Frest, 1996), especially in California, Oregon, Idaho, and Utah [note that some records there regarded as Pliocene may be Miocene: Repenning *et al.*, 1995).

Small (< 5 mm height) *Fluminicola* species, which generally differ considerably anatomically from large taxa, in good part occupy areas outside the range of the larger forms. This is particularly notable in the Oregon Interior Basins and other areas on the Great Basin periphery. Curiously, they are sandwiched in between the larger, often coastal large *Fluminicola* and the basically Great Basin *Pyrgulopsis*. So far, there are no coastal representatives, even though small *Fluminicola* occur in the upper and middle portions of some of the larger western rivers with coastal mouths, *e.g.*, the Umpqua, the Rogue, the Klamath, and the Sacramento. Considerable species differentiation has taken place, if, *e.g.*, the Upper Klamath Lake Drainage and Interior forms are compared. The fossil record for these small taxa is poor; and only a few have so far been described (*e.g.*, Hershler & Frest, 1996; Hershler, 1999).

Another particularly characteristic western hydrobiid genus is the precinctive *Pristinicola*. This taxon has long been known; but only recently shown to be widespread and common (Hershler *et al.*, 1994). Since 1994, we have doubled the number of sites again and expanded the range to its current state. The genus occurs in small cold springs and seeps, coastally from southern Grays Harbor, Mason, Kitsap, and Pierce cos., Washington to Del Norte County, California: in interior Washington south of the Wisconsinan glacial margin to the Idaho Panhandle; south to the western Salmon River drainage; across the northern third of Oregon; and south through the Willamette Valley to the California border. Sites in the Great Basin are rare and peripheral; the eastern range boundary remains to be fixed, although the genus is absent from the middle Snake River and southeastern Idaho.

*Pristinicola* shows no close resemblances in morphology to any eastern North American forms. It is convergent in shell morphology on the European *Bithynella*; and perhaps even more strongly so on the pomatiopsinid tribe Erhaiini, which has a similar ecology (for most recent review, see Davis & Kang, 1995; see also Davis *et al.*, 1985 and Davis *et al.*, 1992). At present (Hershler *et al.*, 1994), *Pristinicola* is classified as a lithoglyphinid hydrobiid; but this placement is dubious (Hershler, pers. comm., 1998), and possible relationship with the aberrant pomatiopsid Erhaiini is suggested here, but needs confirmation. Note that such relationship would strengthen the importance of the Asian element in the western North American malacofauna, especially if such Japanese supposed hydrobiids as *Akiyoshia* prove to have pomatiopsinid relationships.

Most hydrobiid (or rissooidean) endemicity seems to result from differing historical, rather than habitat, factors. *Pyrgulopsis*, "*Lyogyrus*", and both small and large *Fluminicola* species often occupy substantially identical habitat; indeed, they co-occur quite happily in some drainages. There are some habitat preferences worth noting here, however. *Fluminicola virens* and related species occur mostly in streams. *Fluminicola fuscus* and similar species are also primarily amniphile forms, found mostly in larger Columbia River streams. *Fluminicola coloradensis* and similar species occupy springs and spring-influenced streams. Forms like *F. seminalis* may be deployed in the full range from river mouth to headwater streams and larger springs. Small *Fluminicola* species are found mostly in springs, spring creeks, and river headwaters. Only a few forms inhabit lakes; and there, mostly spring-influenced areas. "*Lyogyrus*" occurs almost entirely in seeps, springs, and spring-fed lakes; but occasionally in more standard kettle lakes. *Amnicola*, as in the Eastern US, occurs in lakes; but Western stream habitats so far lack this genus, in contrast to its common amniphile habits in the east. *Pristinicola* is found in seeps, smaller springs, and spring-fed small streams.

*Pyrgulopsis* has cold and warm stenothermal lineages, with most species found in cold springs, including some with enhanced salinity (Hershler, 1998). Stream forms are rare, except along the Great Basin periphery. Lake forms are also rare, particularly living representatives; and most of these actually are found in spring-influenced areas of lakes or limnocrenes.

*Tryonia* has both brackish and freshwater forms. The latter are fairly common in the southern part of the NW assessment area, often on soft substrates. There may be physiological as well as historical reasons, however, for the current absence of *Tryonia* from much of the assessment area, especially given that it did occur in southeastern Idaho during the Pleistocene, and still is found in central and western Utah (Taylor & Bright, 1987; Hershler, 1999). Some hydrobiid species have very patchy current distributions due to habitat limitations (obligate thermiphiles are obvious examples) or later habitat modification, *e.g.* of springs. Still, many of these taxa may have historically been somewhat limited in occurrence, with essentially a relict distribution pattern like that of *Helisoma* (*Carinifex*) *newberryi*. Examination of the fossil record and current habitat can often readily distinguish taxa rare as a result of recent, human-caused habitat disturbance from those genuinely rare or limited by recent geologic history.

*Vorticifex* has both an unusual distribution and habitat. It is present in California in the Sacramento system, and as disjuncts in springs on the Great Basin periphery. In Oregon, it is widespread in the Upper Klamath Lake drainage, but not in other parts of the Klamath system. It is absent from the coastal drainages generally, and from the core Great Basin. In the Columbia, it occurs sporadically, from Grand Coulee to the mouth; and in a few large tributaries, such as the Willamette and the Deschutes in Oregon and the lower and middle Snake in Idaho and Washington. The primary habitat is streams; but the genus also occurs in larger springs and spring-influenced ponds and lakes. It is quite common as a pluvial lake fossil. Generally, it occurs on pebbles and cobbles, often in areas with considerable velocity. In springs and lakes (more

rarely streams) it can occur on macrophytes; but even here, more often on cobbles and boulders. Stable hard substrate is the principal *desideratum*.

Many of the few larger NW bivalve species have (or had historically) broad ranges. Exceptions are *Anodonta wahlametensis*, disjunct from California into the lower Columbia River, and *Margaritifera* n. sp. 1 (Taylor, 1988a), confined to southeastern Idaho. Certain species have the bulk of their distribution in the ICB: examples are *Gonidea angulata* and *Anodonta oregonensis*. Outside of California and Arizona, most of the range of the candidate *Anodonta californiensis* is within the NW. As noted above, most sphaeriids are broadly distributed in the NW, exemplifying a pattern common worldwide. The two exceptions are good examples of relict distributions (*e.g.*, *Pisidium* (*C.*) *ultramontanum* and the Modoc peaclam: Taylor & Bright, 1987, Figure 6).

**Western Mollusk Biogeography Revisited**

Early on in this section, we had concluded that the Henderson (1931) terrestrial-aquatic provincial scheme for Western North America (see especially Figure 2) still had some relevance. It may be appropriate here to revisit that arrangement in the light of newer information and to point out some of the remaining problems. The basic provincial arrangement, always allowing for somewhat fuzzy boundaries, seems quite stable; we have ventured to suggest some relatively minor adjustments (Figure 2).

Bequaert & Miller (1973) expanded the definition and range of the Southwestern Province somewhat in their exhaustive review of Arizona mollusks. This work remains largely comprehensive for terrestrial forms: and their slightly expanded borders, based primarily upon the distribution of the shelled land genera *Eremarionta*, *Holospira*, *Sonorella*, and *Ashmunella*, seems quite robust 25 years later.

The definition of the Washingtonian and Rocky Mountain provinces is still largely the same, with the Washingtonian reasonably characterized by the land snail genera *Allogona*, especially *A.* (*Dysmedoma*) *ptychophora ptychophora*; *Cryptomastix* (*C.*), especially *C.* (*C.*) *mullani mullani*; *Polygyrella polygyrella*; some lineages of *Oreohelix*; and such taxa as *Helicodiscus salmoneus* and *Microphysula ingersolli ingersolli*. Note also that such taxa as *Monadenia* and *Vespericola* are absent from this Province. We expand the borders slightly, to take in more of western Montana and eastern Idaho, interestingly bringing it more in line with current drainage divides.

We expand the Oregonian slightly eastward, to take in the Upper Klamath Lake drainage and portions of northern California just west of the Great basin. This is in part because of the occurrence there of *Vespericola* (two lineages at least: that of *V. shasta* and that of the very different *V. sierranus*) in this region. *Monadenia* has also long been known to extend into the Upper Klamath Lake drainage. So far, we have not seen this genus in the upper Pit drainage.

Rocky Mountain Province borders remain problematic, just as they were for Henderson (1931). Much of the Province is defined by the absence of typical Western Division genera, except for diverse *Oreohelix*. The position of Nevada remains questionable, in part because of inadequate knowledge of the land mollusk faunas of the western half of the state and of adjoining northeastern (Great Basin) California. Nevada *Oreohelix* seem largely different from those of Utah, southeastern Idaho, southwestern and central Montana, and western Colorado and Wyoming.

We differ most in recognition of the Klamath region as a separate Province and in the large size assigned to it. We would thus restrict the Californian largely to central and southern California, with its numerous *Helminthoglypta*, *Micrarionta*, and related genera. Note that we do include a large portion of coastal northern California, as well as the Sierra Nevada, in this Province, plus portions of southwestern Oregon. Our reasoning has been detailed above; but involves the center of distribution of, and southern extent of, *Vespericola* and *Monadenia* (*Monadenia*); plus distribution of such genera as *Trilobopsis*; the remaining two *Monadenia* subgenera (*Shastelix* and *Corynadenia*); occurrence of *Pomatiopsis*, *Megomphix*, *Polygyroidea*, and *Ammonitella*; and rather sparse occurrence of *Helminthoglypta*. Absence of such Oregonian genera as *Allogona*, *Cryptomastix*, and *Hemphillia* also influenced Province borders. The Sierra Nevada is an unusual area in itself, related geologically to the Klamath Mountains and regarded by many geologists as part of a common Klamath terrane, now sundered into two portions (see, *e.g.*, Alt & Hyndman, 1996). It is this history that has perhaps most influenced us to retain the area in the Klamath Province. It should be noted that there are a number of uniquely Sierra Nevada mollusks. Most striking are *Monadenia* (*Corynadenia*); *Polygyroidea*; and *Ammonitella*.

It is instructive to compare the provincial scheme with that arrived at by geographers, ostensibly derived from a combination of geological, climatological, and plant biogeographical considerations. There are several such currently; but perhaps the most widely used is that of Bailey *et al.* (1995). We will compare just the Oregon and Washington portions for brevity.

Our Oregonian would be roughly equivalent to the Olympic Peninsula, Puget Trough, Northern Cascades, Southern Washington Cascades, Coast Ranges, Willamette Valley, and the northern halves of the Western Cascades and High Cascades physiographic provinces. The Washingtonian mollusk Province would be roughly equivalent to the Okanogan Highlands, Columbia Basin, and Blue Mountains physiographic provinces. The Klamath Province would be somewhat comparable to the physiographic Klamath Mountains, southern halves of the Western Cascades and High Cascades, and part of the Basin and Range provinces.

There are solid reasons to prefer one or the other scheme. The most notable difference is that the mollusk provinces generally combine several physiographic units. Degree of desired resolution might be a factor in choosing one or the other scheme, depending upon one's intent. We find that there are certain drawbacks of the physiographic scheme, particularly in doing historical biogeography. The physiographic scheme reflects mostly modern drainages and modern climatic parameters. Thus if one's focus is upon

current factors, such would be most helpful. However, for examination of the biota, it is sometimes much more useful to factor in past drainages and climates. At least for mollusks, substantial parts of the local fauna typically are partly or wholly incongruent with the prevailing climate, drainage, or both. For the more motile or faster-moving groups, the physiographic scheme would likely be a better choice. As regards plant biogeography, much would depend upon which portion of the flora had aroused one's interest; or, *e.g.*, whether current prevailing ecology at a landscape scale, detailed community work, or historical phytogeography were the study focus.

One drawback of all of the combined physiographic schemes we have examined is that treatment of geologically-determined factors generally lacks a historic element, as if all portions of a given area had arisen at the same time or had comparable histories. Generally, the treatment of geology and tectonics in such schemes is cursory or superficial, to say the least. In choosing a provincial scheme, it would probably be best to completely divorce physiographic features *per se*, such as slope, altitude, climate, regolith, etc., from historical factors. It would appear that such foci of interest as keeping track of changes from the immediate past at a coarse scale; or of evaluating changes in now-predominant plant communities could safely largely ignore the historical element.

However, smaller plant communities, the relict element, and plant and animal groups with lesser motility or slower rates of reaction to change might not fit well into schemes based upon modern prevailing physiography and climate. This is important, in that a large part of total biodiversity, perhaps most, could fall into these groups. Often, the most interesting part of a local biota consists largely of just such taxa. Moreover, often neglected in such an analysis is the importance and scale of change. Particularly currently, when landscape-scale changes of various sorts are taking place with unusual rapidity and severity across most of our land area, focus on the historical element and so-called "rare", relict, or uncommon species may actually be most useful in the long run.

After all, current predominant plant communities (prior to extensive human modification), drainages, and climates are themselves geologically youthful, at best resulting mostly from ice-age drastic climate and physical changes, with only some ten thousand years or much less to stabilize. In many areas, current plant- or animal-based biomes should postdate the Hypsithermal (or Altithermal) and could have begun to assemble only after the mid-Holocene. Effects of the mini-ice age (ca. 2,000 YBP) must also be taken into account, at least in some areas. Hence, even our so-called current tiny slice of time and habitat parameters is a composite of varying ages and stability.

Given that we remain in a glacial/interglacial cycle; and that our own climatic influence is now at a near-global scale (and global warming is only one possible example), it would seem extremely worthwhile to broaden the standard perspective on biogeography and biodiversity to include at least a Pleistocene, if not Late Cenozoic, historic element; and to adjust our baseline scale for both problem analysis and land/biotic management to an equally long-term perspective.

A few additional observations on Western mollusk biogeography may be useful here. The largely terrestrial-based provinces we employ seem to have some, but not complete, relevance to freshwater biogeography as well, Certainly, the Klamath region, for example, would seem to be center of origin for such genera as *Juga*, *Fluminicola*, and the Lancidae. However, it was also useful to regard the Great Basin as a separate unit; or even to separate off the "*utahensis-newberryi*" region around the periphery: Taylor (1966b, p. 17) regarded this area as "the dominant pattern in the living fauna of the west". In a larger sense, it was useful occasionally, for both terrestrial and freshwater mollusks, to discriminate between the coastal (Oregonian, Klamath, Californian) and interior (Washingtonian, Rocky Mountain) provinces. More generally, another provincial grouping would seem useful. The Oregonian, Washingtonian, and Klamath share a number of elements lacking elsewhere. In particular, the distribution of some polygyrid genera (*Cryptomastix*, *Allogona*) and the haplotrematid species *Haplotrema* (*Ancomena*) *vancouverense* and *Haplotrema sportella* (*s.l.*) should be emphasized. Freshwater taxa with rather similar distribution include *Fluminicola* (both large and small), *Juga* (all three subgenera), lancids, *Vorticifex*, *Pristinicola*, and, to a lesser degree, western amnicolinids. The Rocky Mountain area mostly lacks the Western precinctives, either terrestrial or freshwater, with two important exceptions, the land snail *Oreohelix* and the freshwater gastropod *Pyrgulopsis*. However, one or the other of these is missing from substantial portions of the Province; and overlap between the two is not necessarily strong, as witness southeastern Oregon and western Nevada.

Looking at important Western precinctives, the coastal provinces (including the Californian, along with the Oregonian and Klamath), the Washingtonian, and the Southwestern are similar in that each has several such genera; the Rocky Mountain Province, however, only has two: *Oreohelix* and *Pyrgulopsis* (and arguably *Tryonia*): of these, one (or two, including *Tryonia*) also occurs in the Eastern US. Interestingly, this means that the Rocky Mountain Province, which occupies a central position in the biogeographic hypotheses of Roth (1986a) and Roth & Emberton (1994), is currently rather depauperate as concerns Western forms.

It should be clear by now that the drainage approach as used by Burch (1989) for freshwater mollusks may not be very useful. The Pacific Coast drainages, for example, do not seem to form a coherent unit, but are best divided into at least three units. California coastal drainages south of the San Francisco Bay area seem rather different than those in the Klamath region. North of southwestern Oregon faunas are again quite different; and north of the Late Wisconsinan glacial margin, one loses such precinctives as *Fluminicola* and *Juga*. Distributions of the major Western precinctives often has little to do with current drainage patterns and more to do with historic patterns. The Columbia drainage also seems to be incoherent unless Late Cenozoic changes are factored in. The Great Basin or Interior drainages form a more consistent unit; but even there, drainage changes on a large scale mean that the distribution of such major genera as *Fluminicola* (*s.l.*) and *Pyrgulopsis* cannot easily be accommodated to the present drainage border. Moreover, major features of the Late Cenozoic pattern, such as those captured in part by the

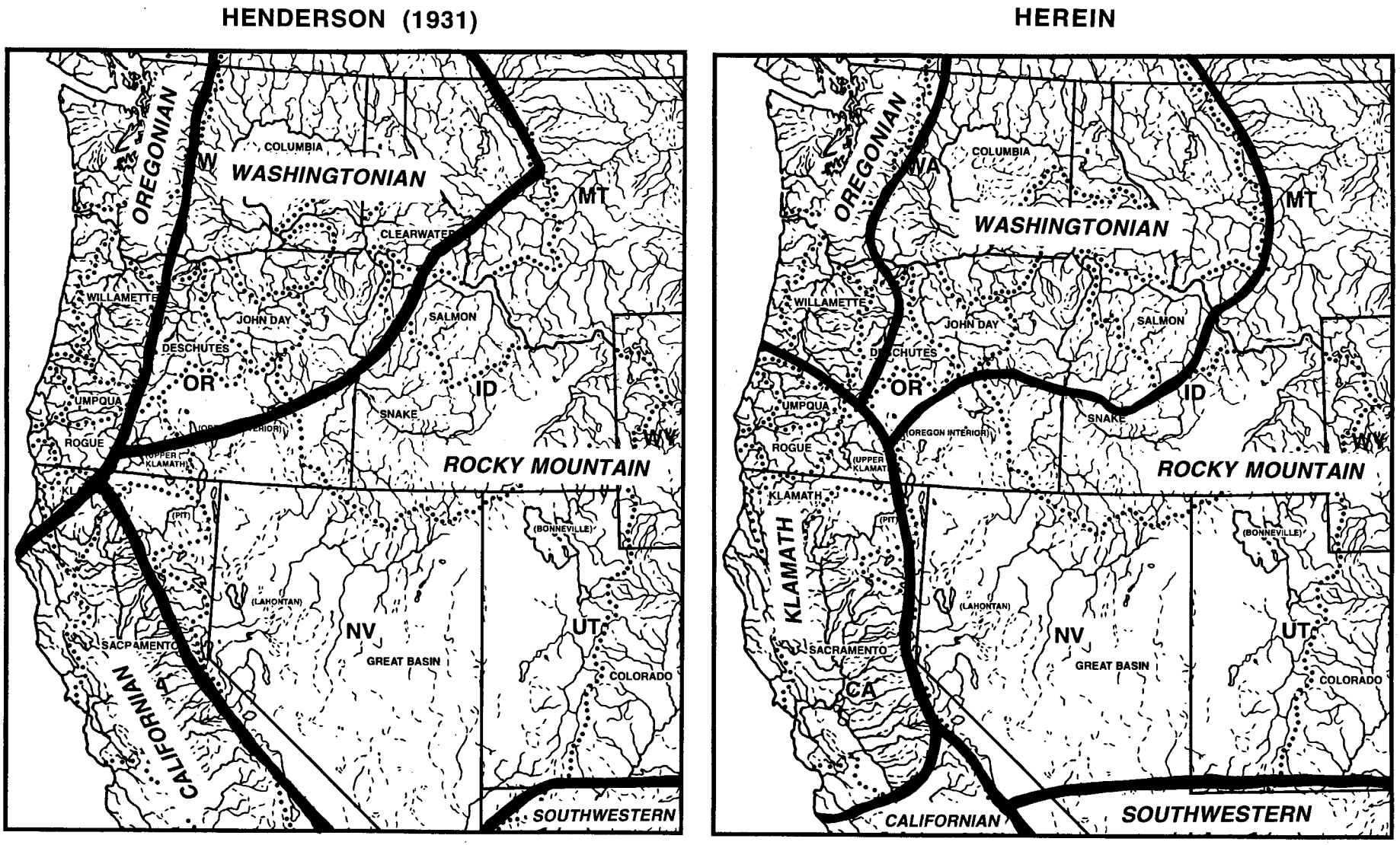


FIGURE 2. Mollusk biogeography of the Northwest. Henderson (1931) scheme at left; the arrangement used herein at right. Province names in oblique typeface. Heavy black lines separate units; contacts, however, are zones, rather than sharp boundaries.

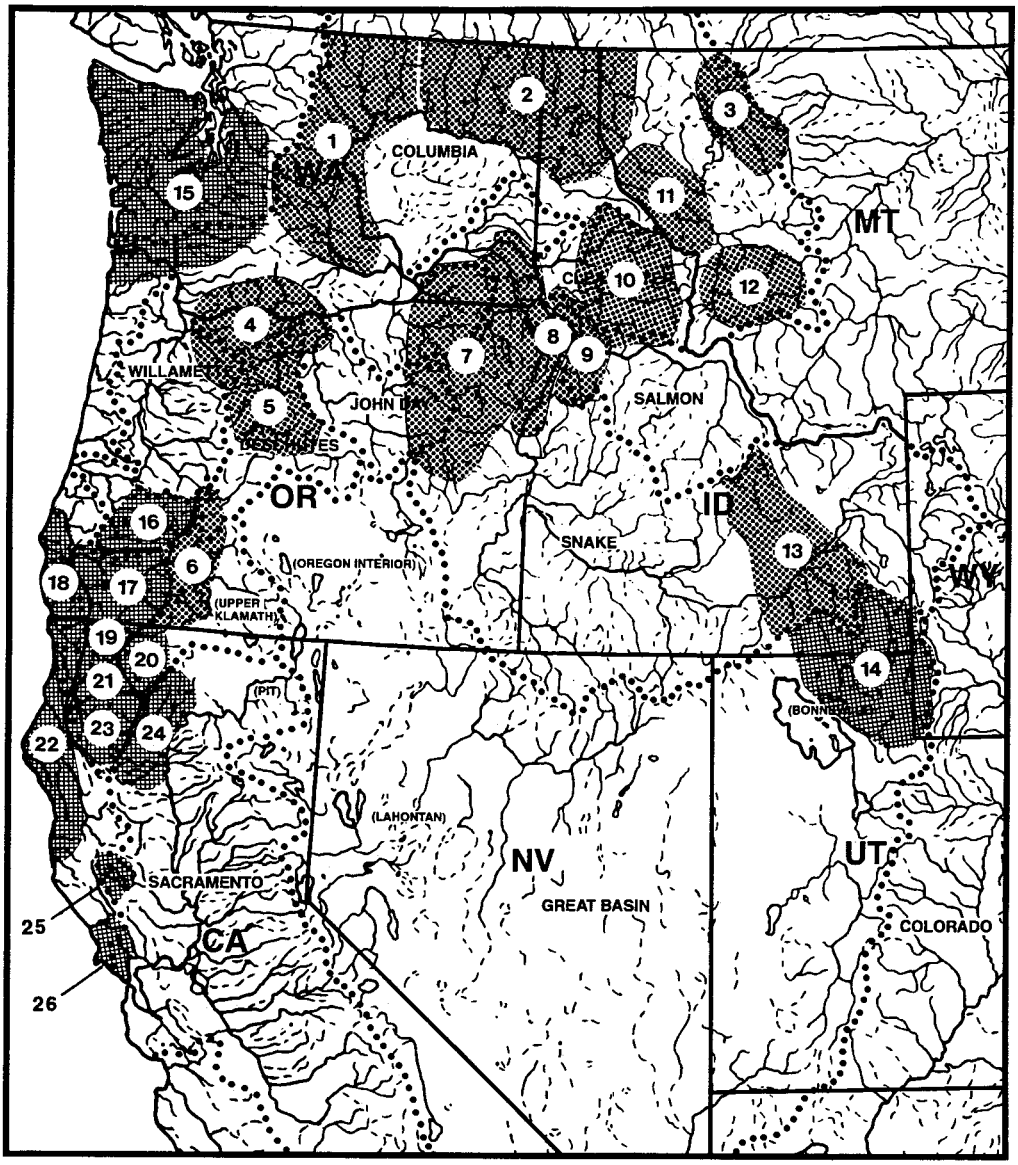


FIGURE 3. Regions with substantial terrestrial mollusk endemicity in the assessment area (dotted pattern) and adjoining portions of the western United States (crosshatched pattern). For details, see text. 1- Washington eastern Cascades; 2- Northeastern Washington-Idaho Panhandle; 3- Mission Mountains and vicinity, Montana; 4- Columbia Gorge, Washington & Oregon; 5- Lower Deschutes drainage, Oregon; 6- Upper Klamath Lake-Crater Lake area, Oregon; 7- Blue Mountains, Oregon & Washington; 8- Hell's Canyon, Idaho, Oregon, & Washington; 9- Lower Salmon drainage, Idaho; 10- Clearwater drainage, Idaho; 11- Bitterroot & Flathead drainages, Montana; 12- Clark Fork drainage, Montana; 13- Southeastern Idaho upper Snake Basin & Range; 14- Wasatch ranges, Utah & Idaho; 15- Olympic Mountains, Puget Lowlands, Willapa Hills, Washington & Oregon; 16- Upper Umpqua drainage, Oregon; 17- Upper Rogue drainage, Oregon; 18- Southwestern Oregon Coast; 19-Lower Klamath drainage, California & Oregon; 20- Shasta Canyon and vicinity, California; 21- Salmon and Marble ranges, California; 22- Northwest California Coast; 23- Trinity drainage, California; 24- Upper Sacramento drainage, California; 25- Clear Lake and vicinity, California; 26- Point Reyes Peninsula and vicinity, California.

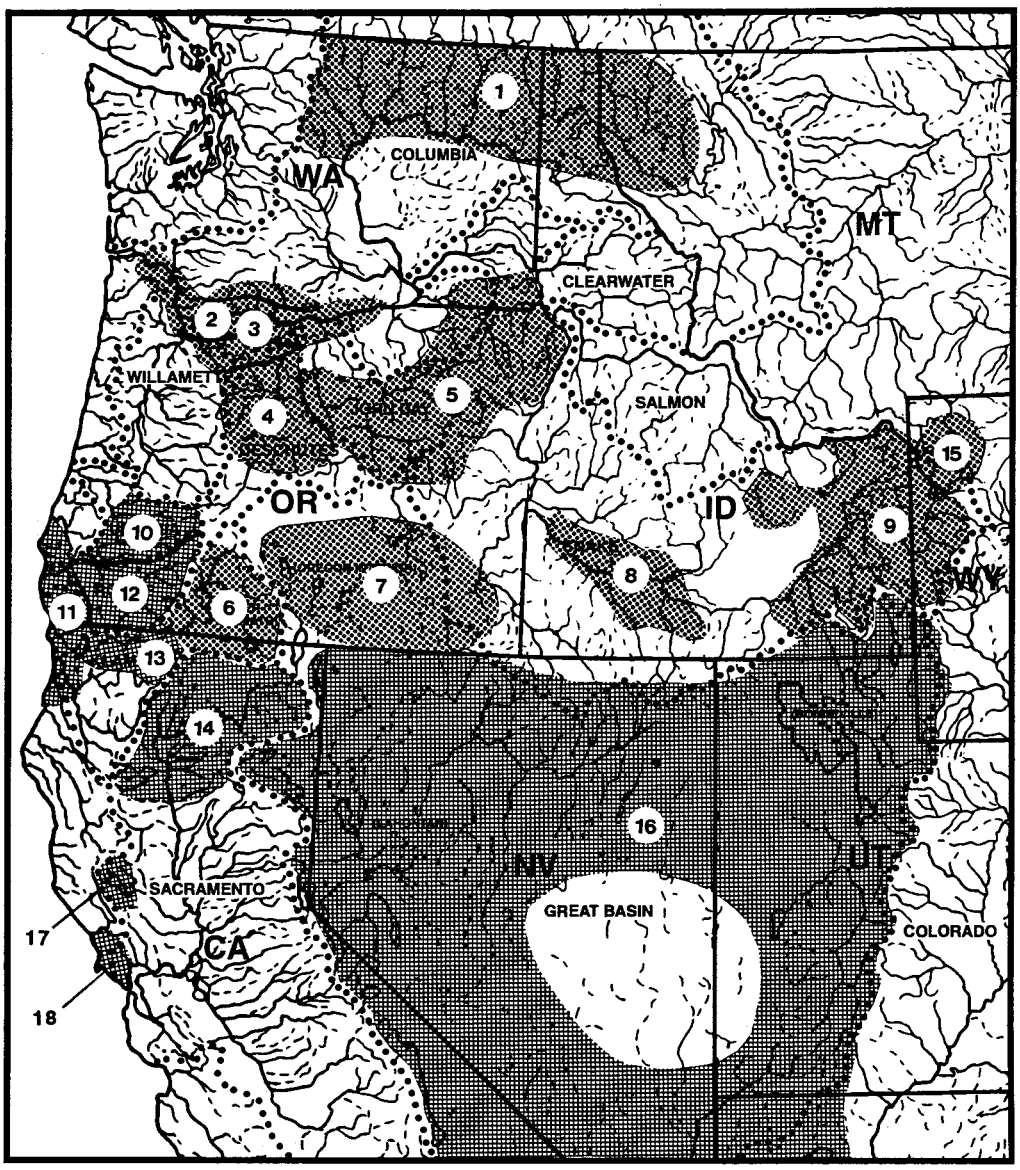


FIGURE 4. Regions with substantial freshwater mollusk endemicity in the assessment area (dotted pattern) and adjoining portions of the western United States (crosshatched pattern). For details, see text. 1- Northern Washington, northern Idaho, and northwestern Montana; 2- Lower Columbia River, Washington & Oregon; 3- Columbia Gorge, Washington & Oregon; 4- Lower Deschutes drainage, Oregon; 5- Blue Mountains, Oregon & Washington; 6- Upper Klamath Lake drainage, Oregon & California; 7- Oregon Interior Basins; 8- Middle Snake River drainage, Idaho; 9- Upper Snake River drainage, Idaho & Wyoming; 10- Upper Umpqua drainage, Oregon; 11- Coastal southwestern Oregon and northwestern California; 12- Middle and Upper Rogue drainage, Oregon; 13- Middle Klamath drainage, California & Oregon; 14- Upper Sacramento & Pit drainage, California; 15- Jackson Lake and vicinity, Wyoming; 16- Undifferentiated Great Basin. Several endemic clusters are known from this area, *e.g.* Bonneville drainage; Sevier Lake drainage; Ash Meadows; Pahranagat Valley; Death Valley; see also Hershler (1998); 17-Clear Lake and vicinity, California; 18- Point Reyes Peninsula and vicinity, California.

fishhook concept, continue to be reflected quite widely in the extant fauna. The terrestrial provincial scheme would seem at least as relevant; and perhaps the most useful solution would be to define freshwater mollusk provinces based at least in part upon Late Cenozoic drainage patterns.

## AREAS OF ENDEMISM

In the full Frest & Johannes (in press) some 40+ areas of mollusk endemism are discussed in detail. For the present purposes, only those areas which occur wholly or partly in Idaho are discussed here . Also included are a few areas that might overlap into Idaho. See figures 3 & 4 herein for location of these areas. References in this section to either figures or table otherwise refer to Frest & Johannes (in press).

1) northern Washington and northern Idaho, northwestern Montana (Figure 38, area 1; Table 37). This region has at least 9 freshwater endemics, of which 2 so far are known to be narrow endemics. Most unusual taxa have congeners in eastern and central North America, presenting a picture very different from that typical for ICB endemics. This region was recently glaciated; major drainage rearrangements combine Columbia with former Mississippi connections, and the fauna derives in equal parts from both. Examples occur in the hydrobiid genera "*Lyogyrus*" and *Amnicola*. These amnicolinids are generally thought to be eastern in affinity; but recently some western species were discovered, mostly narrow endemics. These mostly appear very different from eastern forms; but one each in this region closely resemble some eastern (Mississippi drainage) taxa. The land snail endemic region largely overlaps, but has somewhat different boundaries (Figure 37, areas 1 & 2: see preceding and next section).

2) northeastern Washington-Idaho Panhandle (Figure 37, area 2; Table 18). Characteristic are Washingtonian taxa, including endemic *Cryptomastix* (*C.*) species and the monotypic slug *Magnipelta*. At least 9 species are involved, of which several are strict endemics. The history is similar to that described for the foregoing section. This area lies mostly at the western margin of the Cretaceous continent, and shows a mix of Rocky Mountain and Washingtonian Province elements.

3) lower Salmon River, Idaho (Figure 37, area 9; Table 26). This region has long been known for its remarkably diverse terrestrial mollusk fauna, especially unusual for an arid area. A minimum of 31 taxa are involved, of which at least 22 are strict endemics (Frest & Johannes, 1995b). This is the largest number of terrestrial endemics for any of the ICB regions, and is especially interesting in that the geographic area involved is relatively small. A similar endemic region lies immediately west (see next section). The area shows a diversity of substrates and plant communities. A major fault valley, the lower Salmon River includes numerous blocks of accreted terrain of various lithologies and ages, as well as areas affected by Grande Ronde flood basalts and intrusion of the Idaho Batholith. Species commonly occur on one side of the river only, and have ranges of a few miles or less. Substrate control and altitudinal speciation are very evident. As yet, all terrestrial endemics are large species; but that may reflect overly conservative taxonomy. Endemism is at the species level, and most endemics occur in two genera,

*Cryptomastix* and *Oreohelix*. There are several (at least 8) freshwater endemics present in the region; but only 2 narrow endemics (the possibly extinct *Fluminicola minutissimus* and an undescribed *Valvata*) have been discovered thus far.

4) Hells Canyon, Idaho, Oregon, and Washington (Figure 37, area 8; Table 25). Like the last area, this endemic region is small in geographic extent but has an especially diverse terrestrial mollusk fauna. No endemic slugs have been reported as yet; but there are at least 13 large land snail endemics (Frest & Johannes, 1995a). Thus far, endemism is at the species level only. Most of these are species of either *Cryptomastix* or *Oreohelix*. Some species are confined to single small drainages or individual exotic terrain blocks, and major turnover occurs between the north and south portions of the canyon, such that no single large species is common to both. Geologically, this region is on or near the edge of the Cretaceous continent. Many accreted blocks of limestone and other lithologies were emplaced during and after the Cretaceous, and the region may be part of the so-called Wrangellia Terrain (*s.l.*). Post-Cretaceous deformation and uplift are considerable, as is Miocene-Pliocene volcanism. Rapid downcutting occurred late in the area's history, with Hells Canyon being added to the Snake system only perhaps 600,000-800,000 YBP (Wheeler & Cooke, 1954; Malde & Powers, 1960; Taylor, 1985; Malde, 1991). The freshwater fauna, while including several rare taxa, seems to lack strict endemics.

5) middle Snake River, Idaho (Figure 38, area 8; Table 56). Another rather limited area geographically, the middle Snake River drainage harbors at least 11 freshwater endemics, of which at least 5 are restricted to it. Most are relicts of Pliocene Lake Idaho, a large pluvial lake which had at least 90 freshwater mollusk species, of which perhaps 75 were strict endemics (Taylor, 1985; Taylor, 1977 unpub.; Taylor & Bright, 1987). This is perhaps the largest reported fauna for a single lake, fossil or modern. Formation of the Snake River Plain and migration of a hot spot toward Yellowstone National Park, with accompanying volcanism, influence mollusk distribution and history profoundly. Land snails are very rare throughout this region, and none appears to be endemic. Essentially all federally listed mollusks in the ICB are from this area.

6) southeastern Idaho (upper Snake River drainage) (Figure 38, area 9; Table 57). This portion of the state is part of the Basin and Range physiographic Province, except where intersected by the Snake River Plain. Mountain range uplift and later volcanism are salient events influencing the fauna. The freshwater fauna is especially diverse, and includes at least 21 endemics, about 13 strictly confined to the region. Most are *Pyrgulopsis*, *Fluminicola*, or "*Lyogyrus*" (s.l., including *Colligyrus*) species. Most narrow endemics occur in the limestone mountain ranges, with only a few on the Snake River plain proper. This region likely should be subdivided between the upper Snake tributaries and Bear River (Lake Bonneville) tributaries, as has been done for the land snails (Figure 37, areas 13 & 14). The land snail fauna of area 13 is poorly known, but includes at least 4 narrowly endemic *Oreohelix* species (Table 29). As the land snail fauna of the adjacent Wasatch Range in Utah (area 14) has numerous endemics, particularly in *Oreohelix* (*haydeni* group; *peripherica* group), it is expected that this region will be similar when completely collected. As with the middle Snake River, relatively few species occur on the Snake River Plain itself.

7) Jackson Lake and vicinity, Wyoming (Figure 38, area 15; Table 58). This rather limited area has precinctive forms of *Helisoma* (*Carinifex*) and *Pyrgulopsis*, plus several more regional endemics. These live in the lake proper and nearby springs and spring-fed tributaries. Jackson Lake is notable as a northern outpost for Great Basin forms, a fact which shows up not only in the modern mollusk fauna, but in the fossil record as well (Taylor, 1966a, 1985). This lake also had until recently its own endemic sucker species, belonging to the Great Basin genus *Chasmistes* (Miller & Smith, 1981), as well: but this is now believed extinct (Scoppettone & Vinyard, 1991).

The land snail fauna of this region is too poorly known at present to evaluate for endemics: preliminary work done by us in 1991-1993 indicates the likely presence of two or more endemic *Oreohelix*.

8) the Clearwater River drainage (including the Lochsa and Selway rivers), Idaho (Figure 37, area 10; Table 24) has a substantial endemic terrestrial mollusk fauna, including at least 14 species, more than half of which are strict endemics. Most are large forms in the genera *Cryptomastix* and *Oreohelix*; but *Allogona* and *Anguispira* have local species as well, and the slugs are also unique. Faunal affinities are largely Washingtonian, with a few Rocky Mountain elements. This region has a history similar to that of the lower Salmon River and Hells Canyon, except that Idaho Batholith influence is less significant, while Miocene-Pliocene basalt coverage is more extensive. The freshwater mollusk fauna of the Clearwater River drainage is not known to have a large number of endemic taxa, although the lower Clearwater *Fluminicola* likely is (Hershler & Frest, 1996). Freshwater mussels in this drainage are in better condition than in much of the ICB.

9) Jackson Lake, Wyoming, and adjacent parts of the upper Snake River drainage (Figure 38, area 15; Table 58) also harbor some unique molluscan faunal elements, all freshwater forms. Two of the 5 are strict endemics. The area is of interest in that one of the endemics, *Helisoma* (*Carinifex*) *newberryi jacksonensis*, has Great Basin affinities, and marks the northernmost penetration of such elements (along with the now-extinct Jackson Lake chub). The second, the hydrobiid *Pyrgulopsis robusta*, is one of the group characteristic of the Great Basin periphery along the course of the ancient and modern Snake River. This Rocky Mountain region marks the current location of a hot spot (diapire), and is still a highly active area for volcanism. As far as known, there are no land mollusks endemic to this area (Beetle, 1989), and the fauna is small compared to some nearby portions of Idaho and Utah.

## SPECIES DISCUSSIONS

Species-level taxonomy used here largely follows Pilsbry (1939-48) for land snails, except where superseded by more recent works. Examples include the papers of B. Roth and his collaborators in California and Oregon (mostly referenced by species below: see also Roth, 1993, 1996) and the works of W. B. Miller, G. Webb (mostly published in *Gastropodia*), S. S. Berry, and Allyn Smith. Higher taxonomy also is often that of Pilsbry (*op. cit.*), with some later modifications: we follow Burch & Pearce (1990) in preference to Vaught (1989). It should be

emphasized that higher taxonomy of land snails is currently in flux: and some of this uncertainty impacts directly on NW major groups (see, *e.g.*, Emberton *et al.*, 1990; Bieler, 1993; Roth, 1996, 1997; Cuezzo, 1998). For freshwater mollusks, we generally follow Burch (1989) in preference to Vaught (1989); but in some significant cases, we follow Taylor (especially 1981) rather than Burch (1989). Hydrobiid taxonomy is that of Hershler and others (see **REFERENCES**: especially significant are Ponder & Warén (1988) and Hershler (1994; 1998)). For comparison of hydrobiid taxonomy of Vaught (1989) with that of others (and substantive reasons for rejecting the former), see Kabat & Hershler (1993). Fundamentally, the Vaught classification is a literature cull of varying thoroughness. Major monographic revisions by lifetime specialists, *e.g.,* Riedel (1980) and Ponder & Warén (1988), are not reflected in it, and treatment of some families is fraught with errors (see, *e.g.*, Kabat & Hershler, 1993, p. 59-60).

Information on some taxa newly discovered over the past few years is included in Frest & Johannes (1991b, 1993c, 1993e-f, 1994, 1995a-d, 1996a-b, 1997a, 1998a). Common names for species are those recognized by Turgeon *et al.* (1988, 1998) wherever possible. Roth (1993: see also references therein for earlier papers), Roth & Miller (1992, 1993, 1995), and Frest & Johannes (1993c, 1996a, b) have added or suggested later names for some land and freshwater gastropods. New coinages herein are for undescribed taxa, missed species, subspecies, or taxa described subsequent to publication of Turgeon *et al.* (1988, 1998) and not named by others. Wherever practical we follow the guidelines of Turgeon *et al.* (1988, 1998). Note that many valid species (and most subspecies) were either overlooked or not considered for various reasons by Turgeon *et al.* (1988). Especially weak areas are western land snails and Hydrobiidae. Subgenera are not included, and subspecies were incorporated for just a few marine taxa. A revised edition is anticipated in 1998 (B. Roth, pers. comm., 1997); this also excludes subspecies, but does include at least some subgenera.

In order to keep this document at a reasonable length, complete taxonomy and illustrations are not given here. However, brief descriptions of new taxa are included to help demonstrate taxonomic validity and aid in field recognition. When possible, reference is made to a more comprehensive description and to recent, relatively high-quality illustrations. Our descriptions generally feature characters that can be recognized in the field, or with nothing more complex than a hand lens. It should be recognized explicitly that soft-anatomy at the very least provides many more characters and is absolutely necessary for many taxa, such as freshwater snails in the Hydrobiidae (over half the freshwater taxa discussed below) or land snails in the Succineidae. Technical terminology is deliberately kept to a minimum here. For basic land snail terminology, we suggest consultation with such works as Burch (1962) and Burch & Pearce (1990); for freshwater snails, the glossary in Burch (1989) is very helpful. The manuals by Burch (1972, 1973, 1975a, b) are good introductions to the terminology for fingernail clams and larger bivalves. Terminology for mollusk habitat also includes some unique or uncommon terms, or special usages: for these and for basic morphological terms, consult the **GLOSSARY** preceding the **REFERENCES**.

Similarly, we do not here include detailed descriptions of known sites: this would have more than doubled [perhaps tripled] the document's length. Again, consult references for each entry for further information. In most

cases, specific sites are included in our western US database (MolluscDB™) or are scheduled for entry in the future. Some sites for ROD species are included in Frest & Johannes (1996a) or can be gotten from the Pacific Northwest Ecosystems Office (Portland, Oregon) mollusk database. We also (in some cases, particularly when species had commercial value, were showy, new, or restricted to one or two sites) felt it possible that publication of detailed locality information could jeopardize species' survival. As partial compensation for not supplying detailed site information in all cases, we have included references to a number of species range maps published with some of our more detailed reports (e.g., Frest & Johannes (1995a, b).

Time and space also do not permit more than summary discussion of ecology, associates, or current threats, except in a few specific instances. Such information is supplied in brief for all taxa, however. It should be assumed that threats referred to in each entry are current and have been recently (within the last 1-6 years; often within the last 2 years or less) checked in the field by us or others to confirm currency and accuracy. We have attempted to visit type and other significant localities for all taxa involved, and have done so for nearly all (exceptions are specifically mentioned below). We also made a point of examining museum material (generally including type specimens) for all taxa listed in this section. In most cases, we have also collected and preserved topotype or near topotype material for all taxa dealt with in detail.

Similar length considerations have not allowed complete literature citations for each taxon. We have emphasized only major works which represent the current taxonomic consensus; references to others will be found therein. One absence requires comment. We have not dealt with the polygyrid revisions of Vagvolgyi (1968) to any appreciable extent. These were based solely on a few shell features and rather cursory morphometrics. Museum material for *Cryptomastix* typically is comparatively sparse; lacks juvenile features; and has been cleaned, removing periostracal hair in almost all cases. Vagvolgyi's revisions were based mostly upon MCZ collections, which are somewhat limited for *Cryptomastix* (much less so for eastern US polygyrids). Even so, it is instructive to compare the rather spare taxonomic treatment of eastern North American *Triodopsis* by Vagvolgyi (1968) with the richly speciose approach of Hubricht (see Hubricht, 1985 for summary and references). This was done recently in an exceptional work which will remain standard for many years. Emberton (1988) used shell, anatomic, and allozyme features to thoroughly revise eastern *Triodopsis* (*s.s.*). Hubricht's approach was vindicated, essentially *in toto*. A later work (Emberton, 1991) reached the same results for the closely related tribe Mesodontini; the summary paper (Emberton, 1995) compares and contrasts polygyrid phylogenies in detail. Emberton, like nearly all modern workers, considers western North American "*Triodopsis*" (*s.l.*) as mostly belonging to different genera, specifically *Cryptomastix*; but Emberton's (1988) comments on Vagvolgyi's taxonomy are pertinent here also. Another difficulty with the latter's work is the lack of field experience with the animals involved; such elementary errors as terming the Idaho Salmon River a "small tributary of the Snake" would have been avoided easily. Similarly, correlation (or at least some mention) of substrate, geologic history, and co-occurring genera (notably *Oreohelix*) with *Cryptomastix* occurrences might also have been useful. See Frest & Johannes (1995b) for such information. Our own collections of *Cryptomastix* are in any case often much larger than those available elsewhere.

This work is not a field guide; and illustrations are not yet available for many of the undescribed taxa. We hope to assemble such guides for NW taxa in the future. For land snails, the illustrations in Pilsbry (1939-1948) are still useful. Newly described taxa are generally well-illustrated, *e.g.*, the taxa of Roth & Miller and of Hershler (see **REFERENCES**). Roth's forthcoming California land snail guide will be illustrated.

We have carefully reviewed virtually the entire published and much unpublished literature on ICB-Pacific Coast mollusks. Only those taxa are treated for which there exists general consensus or solid, recently collected evidence for validity. In some cases, this has led to the treatment of undescribed forms. This was done for those groups which are widely accepted to be of conservation significance and for which we both have considerable recent collections and have reviewed museum material as well. This practice is becoming common (see, *e.g.*, Solem & Climo, 1990; Emberton, 1996), in part because the quickening pace of human habitat modification requires some notice be taken of such forms if they are to have any chance of survival. However, even this procedure has resulted in the exclusion of many forms which will probably prove valid taxa with further study; but a conservative approach was deemed most appropriate. We have comparatively limited experience with Physidae, Planorbidae, and Lymnaeidae among freshwater forms and Succineidae among land snails; hence, our treatment of these families is especially conservative.

Institutions whose type and other collections either 1) have been examined for taxa dealt with in this project; 2) are referred to specifically in the species entries; or 3) both of the above are listed below. Collection abbreviations are those of Leviton *et al.* (1985) wherever possible. Most of our collection visits were made in 1985, 1991, and 1995. Further such work will be conducted in 1998.

AMNH American Museum of Natural History, New York

ANSP Academy of Natural Sciences of Philadelphia

BMNH British Museum of Natural History, London

CAS California Academy of Sciences, San Francisco

CHAS Chicago Academy of Sciences, Chicago

Deixis Deixis collection, Seattle

DMNH Delaware Museum of Natural History, Wilmington

MCZ Museum of Comparative Zoology, Harvard University, Cambridge

NMC National Museums of Canada, Museum of Natural History, Ottawa

FMNH Field Museum of Natural History, Chicago

LACM Los Angeles County Museum, Los Angeles

Miller W. B. Miller collection, now mostly in SBMNH; specimens preceded by WBM

Roth Barry Roth collection, San Francisco; specimens preceded by BR

SBMNH Santa Barbara Museum of Natural History, Santa Barbara

SDNHM San Diego [Society of Natural History] Natural History Museum, San Diego; also abbreviated SDSNH

Smith Allyn Smith collection; now partly in CAS; specimens preceded by AGS

SSB S. Stillman Berry collection, Redlands, California; much now in CAS; specimens preceded by SSB

UCM University of Colorado Museum, Boulder

UF Florida Museum of Natural History, Gainsville

UI University of Illinois, Museum of Natural History, Champaign-Urbana

UMMZ University of Michigan Museum of Zoology, Ann Arbor

USNM Smithsonian Institution, National Museum of Natural History (NMNH); formerly U. S. National Museum.

Taxa are listed alphabetically within major subheadings, rather than taxonomically, to facilitate location and indexing. Thus, nominate subgenera may not be the first discussed; and new taxa (forms known to be distinct but not formally described) are treated similarly, largely because placement of new subspecies would be problematic if other arrangements were followed. The large number of undescribed forms dealt with will not be surprising to any one who has studied the western US fauna in any detail, or is familiar with current taxonomic practice. It does not represent, *i.e.*, any particular bias on our part toward "splitting", rather than "lumping". There has been considerable work done on western US land and freshwater mollusks; but much more remains to be done. In recent years, there have been relatively few malacologists interested in systematics of western US forms (Hershler & Roth, 1996), and many species have lain unworked in the major natural history museum collections, in some cases for as long as a hundred years. Early taxonomy in some instances undoubtedly oversplit some genera (*e.g.*, Gould & Woodruff, 1986, Woodruff, 1988 on *Cerion*; Roth & Bogan, 1984 and Hillis, Dixon, & Jones, 1991 on *Liguus*); but examples of overly speciose western US genera are rather sparse: neglect or over-conservatism is closer to the norm.

Access difficulties and lack of sufficiently-trained workers, rather than lack of interest, are sometimes the problems, even in areas long known to be exceptional. An example is the lower Salmon River-Hells Canyon area of western Idaho and eastern Oregon. Even though it has been famous for high land snail diversity since the 1860s; and despite the fact that many malacologists have worked it, species continue to be found in recent times (*e.g.*, Solem, 1975; Fairbanks, 1984; Frest & Johannes, 1995a). In this instance, more careful and complete modern reworking of older taxa has led to an increase in the number of full species and total diversity, as well as the prediction that yet more species remained to be discovered (Solem & Clarke, 1974; Solem, 1975), a prediction well borne out in Frest & Johannes (1995a). One other example should be cited. Careful work and extensive collection has recently led to considerable increase in the number of species in the polygyrinid genus *Vespericola*, as well as one new genus (see Roth, 1993; Roth & Miller, 1992, 1993, 1995; Cordero & Miller, 1995); and many more species (and some higher taxa) remain to be described.

A similar example for western US freshwater mollusks has recently been discussed by Frest (1995). As late as 1989, the hydrobiid snail genus *Pyrgulopsis* had only five accepted species. With previously known forms allocated elsewhere added, it still comprised only some 26 taxa in the last comprehensive compilation (Burch, 1989). Due to sustained efforts by the NMNH's R. Hershler since 1985, the latest review of the genus (Hershler, 1994) listed 65 taxa, including some 32 species described since 1985. Eight were described subsequently

(Hershler, 1995a; Thompson, 1995). It is likely that at least 65 western US *Pyrgulopsis* remain to be described (Kabat & Hershler, 1993; Frest, 1995). Hershler (1998) added an additional 58 taxa from Nevada and Utah, bringing the described total to 131. As noted in previous sections, diversity in both land and freshwater forms is concentrated in only a few genera. Such dramatic diversity increases will likely prove exceptional for the fauna as a whole. Nevertheless, the extent and scientific importance of such species clusters should not be underestimated.

The pace of environmental and habitat change in the western US has been so rapid as to outstrip the systematic efforts of taxonomists. As much as in tropical rain forests, there is every reason to believe that many species have already or will go extinct before discovery or description. Again, the premier example is provided by the Hydrobiidae. Of the 65 described *Pyrgulopsis*, over half are currently either extinct, federally listed species, or were until recently listing candidates (Hershler, 1994). Of the 49 western hydrobiid species until recently listed as candidates (USFWS, 1994), 40 were described in the last ten years. Of the 58 *Pyrgulopsis* taxa described this year, at least 2 are already extinct (Hershler, 1998).

Such considerations may explain further why we choose to deal with undescribed forms here. Exclusion of such would result in very considerable underestimation of both the potential and known regional malacofauna. Hence, undescribed taxa are covered here, as far as present knowledge allows. It should be emphasized again that only those forms for which we have adequate range and taxonomic data available are so treated; *i.e.* taxonomically valid forms known to be currently exceptionally rare and in clear danger of extinction. Some other undescribed taxa are known to be widespread and comparatively secure; these are for the most part excluded from consideration, unless habitat limitations, occurrence, or special circumstances indicate that they will soon be in actual danger of extinction.

The status suggestions made below are based upon a variety of criteria. We have been involved with mollusk listings under the ESA since about 1980; prepared National Recovery Plans and status reports for USFWS (*e.g.*, Frest, 1984, 1991); and have written reports to be directly used by USFWS to prepare status reports on certain mollusk species (*e.g.*, Frest & Johannes, 1991c, 1993d). We regularly review Proposed and Final Rules for mollusk species under the Act; and regularly examine available rules and procedures, as published in the Federal Register and as made available by USFWS. Similarly, we have provided the basic mollusk lists and background data for both the Clinton Forest Plan assessment areas (NSO: Frest & Johannes, 1991b, 1993c, 1996a; Roth, 1993, 1996: ICB, Frest & Johannes, 1995a). In general, taxa suggested as Endangered below are regarded as in imminent danger of extinction. Such taxa have relatively few sites known to survive currently; have had much or all of their range surveyed recently; have suffered extensive site and habitat loss in recent years; have had the majority of their habitat lost in historic times; have obvious and clearly definable threats to remaining sites; are known to have suffered considerable population loss in recent years; and are by consensus of informed malacologists valid taxa. Almost all of these taxa are also known to occur mostly or entirely on public lands. Taxa suggested as Threatened below are regarded as in definite danger of extinction. Such taxa have relatively few sites known to survive currently; have had much or all of their range surveyed recently; have suffered considerable site and habitat loss in recent years; have had the majority of their habitat lost in historic times; have obvious and

clearly definable threats to remaining sites; are known to have suffered major population loss in recent years; and are, by consensus of informed malacologists, valid taxa. Almost all of these taxa are also known to occur on public lands.

Suggested listing status is individualized to reflect site condition, population size, likelihood of future site loss, likelihood and nature and effects of threats to remaining sites. Recommendations are thus not completely formulaic despite following a standard format, but represent a synthesis of a variety of factors. Among others considered are the following: proximity to expanding urban areas; occurrence in or near active mining areas; occurrence in areas with valuable material commodities likely to be exploited in the future; ownership (state or federal); state or local land usage policies; accessibility; location along or near major travel corridors; geologic history and land usage history of the occurrence area; plant community; area fire history; population growth trends (where available); area irrigation, grazing, timber harvest, or other disruptive practice suitability; etc. Thus, some species with a number of known sites might be ranked as more at risk than ones with one or several; and estimated overall population size and trends were major factors influencing ranking. Similarly, state rankings are individualized to reflect each taxon's condition within that state, based on the listed factors. Where not all sites are likely to have been discovered to date, best projections are made based on total potential range *vs.* known occurrences, with adjustments made to reflect ecosystem conditions and threats in the incompletely surveyed range portion.

In making these evaluations, we pool data derived from museum collections; a thorough literature review; our own collections in the region (which involve about 4,500 formally established sites, equally divided between land and freshwater habitats, dating from 1987 to the present, as well as many others either not formally defined or located in areas peripheral to the ICB-Pacific Coast); examination of the gray literature; examination of private collections and those of other environmental consultants; and consultations with malacologists and other professionals with original data not otherwise available.

Entry format is rather standardized. Current taxonomy and common name (in or based on Turgeon *et al.*, 1988; 1998) head each, followed by data on **Type locality** and location of type specimens. We then furnish a short **Description** if none has appeared recently; or a reference to such a description and illustration, oriented toward useful field recognition features. Often, **Discussion** of similar forms, synonyms, and history follows. Reference to the appropriate key in **APPENDIX A** is made in this section also, if relevant. Summary sections on **Ecology**, **Original distribution**, and **Current distribution** follow next. Short discussions of **Idaho distribution and comments** and **Specific Idaho sites** follow for the more Sensitive taxa. Sections of direct conservation interest succeed, discussing **Threats** to the taxon, **Criteria for** its **inclusion** here, and **Recommended status** vis-à-vis federal ESA, federal land management regulations (BLM, Forest Service, NPS), and relevant State(s) of occurrence' statutes or regulations. Finally, basic literature **References** are listed.

### *Allogona* (*Dysmedoma*) *lombardii* Smith, 1943
### Selway forestsnail

**Type locality:** Along Meadow Creek, 1 1/2 mi. south of Selway Falls, Idaho County, Idaho, elev. 1900'; holotype CAS 7803.

**Description:** See Smith (1943), Pilsbry (1948), Webb (1968), and Frest & Johannes (1995a, b). This is a large taxon with deep reddish, strongly malleate shell. The lip is relatively wide; the parietal lamella moderately strong.

**Discussion:** A very distinctive form as compared to the widespread *Allogona ptychophora ptychophora*. Specimens with this morphology have not been seen from other portions of the range of *Allogona ptychophora ptychophora*, *i.e.* in Washington, Oregon, Montana, or drier portions of Idaho. Cited as *Allogona* (*Allogona*) *lombardii* in Frest & Johannes (1995a, b).

**Ecology:** This species has been found in relatively intact mixed coniferous forest at elevations ranging from 1500-5800'. It is most frequent in lower-level moist, well-shaded situations in relatively intact forests with considerable duff alongside medium-large streams, particularly at the edge of flood plains (slope base). Most sites have high understory diversity, as well as high land snail diversity. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum.* Noted associates include *Allogona ptychophora ptychophora*, *Polygyrella polygyrella*, *Hemphillia camelus*, *Zacoleus idahoensis*, *Anguispira kochi occidentalis*, *Anguispira nimapuna*, and several *Cryptomastix* species. A definite mesophile.

**Original distribution:** Typical populations occurred along the Lochsa, Selway, and uppermost Clearwater River and their major tributaries, northern Idaho (Clearwater Mountains). The original distribution was probably essentially continuous in this area. A few disjunct colonies of uncertain status (possibly an undescribed form or this species) have been noted recently along a small portion of the lower Salmon River drainage at moderate-high elevations (Frest & Johannes, 1995b).

**Current distribution:** A few isolated populations survive in densely forested areas along the lower Lochsa and Selway River and one major Selway tributary. We have recently recollected the type locality and other sites in the previously known and likely range. It is not likely that later work will greatly expand either the range or number of sites. Current status of some sites (*e.g.,* Branson, Sisk, & McCoy, 1966) needs to be reevaluated. For details and map of lower Salmon River sites, see Frest & Johannes (1995b).

**Idaho distribution and comments:** Appears to be an Idaho endemic. Note that there are two distributional foci, one along lower portions of the Lochsa and Selway and upper Clearwater rivers and the second, which could represent a new taxon, along a couple of lower Salmon River tributaries.

Evidently a taxon with a very limited range currently.

**Specific Idaho sites:** LSR sites 47, 60, 176; 1357, 1388.

**Threats:** Timber harvest and grazing have affected most of the original range. Highways (*e.g.*, US 12) and parks, pulloffs, and other such modifications are concentrated in its preferred habitat along much of the Lochsa and part of the Selway corridors. The species is not found in recently logged or heavily grazed areas.

**Criteria for inclusion:** Local endemic with rather specialized habitat requirements that has lost much of its original habitat; few known or likely sites; old growth and riparian associate. Much remaining is public land subject to logging, grazing, or other potentially imperiling human activities. Most known and former sites are on public land,

including Clearwater National Forest, Nez Perce National Forest, and the Lochsa section of the Clearwater Wild and Scenic River. This species appears to be declining throughout its limited range.

**Recommended status:** Currently this species has no special status. Minimally, it should be considered a Sensitive species by the Forest Service, BLM, and state land and wildlife management agencies. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Threatened is warranted [as recommended by Frest & Johannes, 1995a, b], due to limited distribution, loss of habitat, and threats to remaining habitat.

**References:** Smith (1943); Pilsbry (1948); Webb (1968); Frest & Johannes (1995a, b); Deixis 1989-1994 collections.

### *Allogona* (*Dysmedoma*) *ptychophora solida* Vanatta, 1924
### dry land forestsnail

**Type locality:** Cottonwood Tree Canyon, along Snake River, 50 miles south of Lewiston, Nez Perce County, Idaho; holotype ANSP 132476 (Vanatta, 1924). No location with exactly this name and description has been found; however, Cottonwood Creek in Hells Canyon, approximately 40 miles south of Lewiston, is the likely type locality.

**Description:** See Vanatta (1924), Pilsbry (1940), and Frest & Johannes (1995a, b) for descriptions and comparisons. This subspecies is more strongly depressed than the nominate subspecies; the shell is generally greenish in color; the apertural lip is white and more prominent (wider) than that of *ptychophora s.s.* The body is generally black or dark gray, in contrast to the brownish, pinkish, or pale off-white typical of both *lombardii* and *ptychophora ptychophora.* Cited as *Allogona* (*Allogona*) *ptychophora solida* in Frest & Johannes (1995a, b).

**Discussion:** Limited material, consisting of shells only, was available to Vanatta and Pilsbry. Recent collections demonstrate that this is likely a full species, with distinctive anatomy and body and mantle pigmentation as well as shell features. See Frest & Johannes (1995b) for more information and range map.

**Ecology:** This moderately xerophilic taxon occurs most frequently in comparatively open and dry large basalt taluses, generally at lower elevations, along a limited portion of the northern Hells Canyon (Snake River) drainage, Idaho, Washington and Oregon, the Lewiston and Clarkston area, Idaho and Washington, the lowermost Salmon River drainage, Idaho and Nez Perce counties, Idaho, plus the lowermost Clearwater River drainage, Idaho. Covering vegetation may include *Celtus*, *Artemisia*, *Prunus*, *Balsamorrhiza*, grasses, *Seligeria*, and some bryophytes. It is most frequent on north-facing large taluses, often only at their base. While it is a xerophile as compared to the other *Allogona* species, it avoids the most dry sites, *i.e.*, areas preferred by *Oreohelix haydeni* subspp. and *Oreohelix idahoensis idahoensis.* Common land snail associates include several small *Cryptomastix* species (including *magnidentata* at one former site), *Cryptomastix populi*, *Allogona ptychophora ptychophora*, *Oreohelix jugalis*, and *Oreohelix vortex.* The species has been found occasionally on limestone or metasedimentary substrate.

**Original distribution:** Probably once comparatively frequent in the areas underlain by the Grande Ronde and Columbia River basalts, Snake River, Salmon River, and lower Clearwater River. Most colonies occur at slope base along the major river corridors, not in major tributaries.

**Current distribution:** This taxon now occurs as isolated colonies in relatively undisturbed portions of the original distribution, *i.e.,* roadless areas in the lower Salmon and Hells Canyon. Clearwater and Mission Creek sites appear to be extirpated. Much or all of the known and potential range has recently been surveyed in some detail (Frest & Johannes, 1995b). Other collectors and malacologists have also explored this area, from the 1860s to the present (*e.g.*, H. Hemphill, H. B. Baker, M. Walton, and A. Solem). It is not likely that later work will greatly expand

either the range or number of sites. For details and map of lower Salmon River sites, see Frest & Johannes (1995b).

**Idaho distribution and comments:** This taxon does occur in limited areas of Washington and Oregon; however, the bulk of known sites are in a limited part of Idaho, including a small portion of Hells Canyon and the lowermost 40 miles or so of the lower Salmon River. Thus, largely endemic to Idaho.

**Specific Idaho sites:** LSR sites 15, 79, 81, 83, 84, 86, 87, 88, 89, 90, 100, 101, 125, 126, 147, 148, 157, 158, 159, 160, 210. (about 21 sites).

**Threats:** Grazing occurs over much of the original habitat, and the species appears to be absent from heavily grazed areas. Roads are often located preferentially along the bases of large talus piles in the larger river corridors, *e.g.*, US hwy. 95. Mining of basalt for road metal and for fill has extirpated colonies since 1990, *e.g.,* near White Bird and Lewiston, Idaho. Roadside spraying is a problem for some colonies in both Washington and Idaho. The species' total population size and site numbers are declining.

**Criteria for inclusion:** A local endemic that has lost much of its rather specialized habitat. Remaining colonies are mostly on public lands, including BLM and Nez Perce National Forest properties. Very few sites known or likely. This species is declining throughout its limited range, and colony loss has been observed in recent years.

**Recommended status:** To date, this species has no special status; it should be considered a Sensitive species by the Forest Service, BLM, and state land and wildlife management agencies. There is sufficient recently-collected information, and recent survey work, to recommend Federal and State (Idaho, Washington) listing as Threatened, and Oregon listing as Endangered [as recommended by Frest & Johannes (1995a, b)], due to loss of habitat, some historic sites, and increasing human populations and usage of some or all of remaining habitat.

**References:** Vanatta (1924); Pilsbry (1940); Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Anguispira nimapuna* Baker, 1932
### Nimapuna disc

**Type locality:** Near northeastern corner sec. 32, T 32 N R 4 E, near South Fork Clearwater River, across from Chief Joseph monument, Idaho County, Idaho. Holotype ANSP 156441a; paratypes UCM 22540; ANSP 156441. See Wu & Brandauer (1982) for UCM types.

**Description:** See Baker (1932) and Pilsbry (1948). This is a strongly depressed taxon with a definite peripheral keel and very wide, completely open umbilicus, contained *ca.* 3.5 times in full diameter; whorls 5 1/2-6 (at diameter of about 12 mm). The aperture is unmodified; most specimens are medium brown in color; transverse ribs are moderately developed and slightly irregular, strongest on the upper surface but only slightly less so below. The species is considerably larger than *Discus whitneyi*, the only similar taxon in most of the range, and differs in most features.

**Discussion**: The only western US species at all similar is the very local Montana *Discus brunsoni* (*q.v.*). That species has a comparatively smooth shell; wider umbilicus; weaker peripheral keel; and weak transverse ribs. *Discus marmorensis* (*q.v.*: see also Frest & Johannes, 1995a) is much smaller; has a much narrower umbilicus; narrow, numerous whorls; beehive-shaped shell; and mottled coloration. The specific epithet honors the Nez Perce. This taxon appears to be confined to only a portion of the Clearwater drainage. It is evidently absent from the Lower Salmon drainage (Frest & Johannes, 1995b) and unreported from the eastern side of Lolo Pass or points east.

In contrast to their eastern and central US distribution, discids are generally rare and scattered in the West. No western taxa are as ubiquitous as *Anguispira alternata* and *Discus whitneyi*. The latter occurs here, but only sporadically. Perhaps the most successful western discid is *Anguispira kochi occidentalis*, widely distributed in the Rocky Mountain and Washingtonian provinces. Most other western taxa are rare endemics with what appear to be relict distributions.

**Ecology:** The Nimapuna disc occurs most commonly at lower elevations in streamside moist coniferous forests with common deciduous understory plants and a diverse forb flora in exceptional condition along major drainages. Commonly, forest sites are well shaded (closed or almost closed canopy). In some circumstances, this species may be found also in moist basalt taluses. In such cases, sites are at least partially shaded and are frequently mossy and north-facing, with rather large (boulder-cobble-sized) liths. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. Talus associates include *Polygyrella polygyrella* and *Oreohelix* n. sp. 25 (Stites mountainsnail). Forest associates include *Allogona lombardii* and *Allogona ptychophora ptychophora*, *Anguispira kochi occidentalis*, *Oreohelix strigosa* n. subsp. 1 (Nez Perce mountainsnail) and *Cryptomastix mullani mullani*. A mesophile.

**Original distribution:** South Fork Clearwater River, small portion of Clearwater upstream from Kooskia, and lower Lochsa and Selway drainages, Idaho; probably originally nearly continuous in this area. We have recently revisited the type locality and other sites in the species' range. Some sites are on Clearwater and on Nez Perce National Forest lands; others may be on Nez Perce Tribe properties.

**Current distribution:** Very rare in isolated colonies in portions of original distribution. We have recently revisited both the type locality and other sites scattered through the known and potential range. The species is now quite rare at the type locality, due in part to talus removal. Recent talus mining is common in the South Fork Clearwater River drainage.

**Idaho distribution and comments:** Another strict Idaho endemic, occurring in a very limited area, namely a part of the south Fork Clearwater, lower Clearwater, lower Lochsa and Selway river corridors.

**Specific Idaho sites:** Less than 10 known at present.

**Threats:** Grazing and logging in lowland forest part of distribution; road metal and fill mining of taluses in other areas; roadside spraying is a problem for some colonies; and highway construction (*e.g.*, Idaho 13, US 12) through both habitats. This species does not seem to survive clear-cutting or heavy grazing. It is not likely that later work will greatly expand either the range or number of sites.

**Criteria for inclusion:** Local endemic; old growth and riparian associate, in part; increasing human usage of habitat; some combination of road building, logging, and grazing throughout much of range; small number of extant sites. The species is declining throughout its range, much of which is public land (*e.g.*, Clearwater and Nez Perce National Forests), and recent loss of historic sites has occurred. The trends for population (number of sites, number of individuals) are downward.

**Recommended status:** Currently has none. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Threatened is warranted, due to limited number of sites, loss of historic habitat and sites, concentrated human use of preferred habitat. This same conclusion was reached in Frest & Johannes (1995a).

**References:** Baker (1932); Smith (1943); Pilsbry (1948); Frest & Johannes (1995a); Deixis collections, 1989-1993.

## *Cryptomastix* (*Bupiogona*) n. sp. 1
## Deep Creek oregonian

**Type locality:** None designated as yet; undescribed taxon.

**Description:** Large (to 17 mm), rather flat-spired species, to 5 1/2 whorls in adult. Shell thin; greenish yellow in color; lip off-white, thin but wide, edges barely recurved; columellar insertion far above umbilicus, nearly at whorl midpoint, barely covering any portion of umbilicus. Umbilicus shallow, moderate-sized, about 1/7 full shell diameter. Both upper and lower surfaces distinctly but shallowly convex: the sutures are distinctly impressed.

**Discussion:** This species is related to *Cryptomastix populi* (see below), *i.e.* is a member of the subgenus *Bupiogona* Webb, 1970 [for anatomy of this subgenus, see Webb, 1970b, 1990]; but that species has very different color and apertural features. The Kinney Creek oregonian (see below) is much smaller, has a brown shell, and has a strongly revolute lip. See key 1P (**APPENDIX A**) for further comparisons.

This taxon was discussed in Frest & Johannes (1995a) under the same name.

**Ecology:** Occurs in open to partly forested (*Pinus ponderosa*), rather dry metasedimentary rock taluses at low elevations along a single large creek in vicinity of Hells Canyon Dam, south Hells Canyon, Snake River, Adams County, Idaho. The taluses are generally north-facing, with scattered *Rhus* and grasses except at the base. Snails occur mostly low in the talus, in areas with common grasses and *Prunus* and other woody shrubs, plus small *Populus*, scattered *Pinus ponderosa*, and dense local *Rhus horribilis* stands. Land snails other than *Cryptomastix* are rare, but include *Oreohelix* spp. An atypically xerophile taxon, for *Cryptomastix*.

**Original distribution:** Uncertain; may well have long been confined to single or a few creek drainages.

**Current distribution:** Currently known only from a single series of colonies along Deep Creek, Hells Canyon, Adams County, Idaho. It is unlikely that the range or number of sites will be significantly expanded by future work in Idaho. May occur on the opposite side of the Snake River in Oregon, also in a single drainage.

**Idaho distribution and comments:** A very strict Idaho endemic, found only along a single creek drainage (and then only on one side of the creek)

**Specific Idaho sites:** Effectively, there is only one site, a now fragmented colony along a single accreted terrain block.

**Threats:** Dam construction and maintenance has considerably modified the immediate area, restricting the number and extent of rock taluses, and will likely do so in the future. The area is moderately grazed at present, and the snail is confined to areas not easily accessible to stock. Grazed portions of the talus piles do not have live snails, but long-dead specimens may be found in them, indicating loss of habitat. Colony extent and snail numbers have thus demonstrably declined.

**Criteria for inclusion:** Very local endemic; extensive modification of Snake River valley for dam construction; occurrence on public lands (Payette National Forest).

**Recommended status:** Has none at present. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho; Oregon, if present) listing as Endangered is justified, due to very local occurrence, proximity to major dam, grazing, habitat loss. Note that the same status was recommended in Frest & Johannes (1995a).

**References:** Frest & Johannes (1995a); Deixis collections, 1989.

## *Cryptomastix* (*Bupiogona*) n. sp. 2
## Kinney Creek oregonian

**Type locality:** Undescribed taxon; to be designated.

**Description:** A small (to 13 mm) *Cryptomastix* (*Bupiogona*) species; adults with very low spire, flattened above and below; sutures barely impressed; 5-5 1/2 whorls as adult; shell color light brown. Lip white, flared above and flattened below, slightly and evenly revolute, moderately thick; columellar insertion to upper right of umbilicus, about 1/3 of distance across whorl; umbilicus barely impinged by lip. Umbilicus rather deep, comparatively broad, about 1/6 full shell diameter.

**Discussion:** First mentioned, under the same designation, in Frest & Johannes (1995a). The peculiar apertural shape, small size, and color are distinctive among *Bupiogona* species (see *populi* and n. sp. 1 entries for comparisons: see also **APPENDIX A**, key 1P).

**Ecology:** The species at present is confined to large-scale, generally south-facing, talus piles composed of Late Paleozoic or Tertiary breccia and conglomerate on one side of Kinney Creek. Sites are largely open, with sparse vegetation consisting mostly of *Celtus*, *Rhus horribilis*, grasses, composites, and local moss and spikemoss (*Seligeria*). Interestingly, this species is replaced by another more common *Cryptomastix* species in the moist riparian talus immediately adjacent to the Kinney Creek drainage itself. It is associated with *Oreohelix* n. sp. 17 (the bicarinate mountainsnail) in Kinney Creek itself, but is absent from *Oreohelix* colonies in the next two drainages both north and south of Kinney Creek. A moderate-strong xerophile.

**Original distribution:** Probably restricted to one or a few valleys in the south part of Hells Canyon, Adams County, Idaho.

**Current distribution:** Limited to a few still-viable colonies along Kinney Creek, southern Hells Canyon, on Payette National Forest lands (and possibly on adjoining BLM lands). It is unlikely that the range or number of sites in Idaho will be significantly expanded by future work. May occur in the Oregon canyon opposite Kinney Creek.

**Idaho distribution and comments:** Another strict Idaho endemic limited to a portion of a single Hells Canyon small creek drainage.

**Specific Idaho sites:** See above: effectively, this is one single colony, although grazing and fire damage have somewhat fragmented it.

**Threats:** This valley has been heavily grazed. Colonies are limited to larger talus piles and small protected areas on steep slopes not as heavily grazed. The species is declining in area and numbers, with live individuals rare and large areas of talus with old, long-dead specimens only.

**Criteria for inclusion:** Very local endemic; past mining activities; present and past grazing restricting snail to protected areas; occurrence on public lands.

**Recommended status:** Currently, has none. It should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho; Oregon, if confirmed to live there) listing as Endangered, due to limited range and number of sites, ongoing threats. Frest & Johannes (1995a) made the same recommendation.

**References:** Frest & Johannes (1995a); Deixis collections, 1989-1991.

## *Cryptomastix* (*Bupiogona*) *populi* (Vanatta, 1924)
## poplar oregonian

**Type locality:** "Cottonwood Tree Canyon, on Snake River 50 miles south of Lewiston, Nez Perce County, Idaho" (Vanatta, 1924); holotype ANSP 132939a. This is the same site as the type locality of *Allogona ptychophora solida* (*q.v.*) and is also a site for the rare *Oreohelix* n. sp. 18 (Limestone Point mountainsnail; *q.v.*). We were unable to find a site with precisely this name and description on either current or old maps available to us. However, Cottonwood Creek in Hells Canyon, approximately 40 mi. south of Lewiston, is the likely type locality.

**Description:** See Pilsbry (1940). The species was based originally on 2 dead specimens only. Live material indicates that the dark blue-black body and mantle and wine-red shell color are quite distinctive among described species of *Cryptomastix*, as are the apertural features noted by Pilsbry. See **APPENDIX A**, keys C & P for comparisons with similar species in its range.

This taxon has a nearly flat spire, diameter about 17 mm; moderately impressed suture; 5 whorls; narrow, brown, strongly revolute lip; no apertural lamellae; and distinctive shell color. Anatomy of specimens of this species, collected by W. B. Miller from near Clarkston, Washington, was described and illustrated by Webb (1970b, 1990) under the name *Cryptomastix hendersoni.* The unique features of the male anatomy were the basis for the new subgenus *Bupiogona* Webb, 1970. We have confirmed these features in recently collected *Cryptomastix populi* (com-pared with the type material at ANSP in 1991); by analogy with other triodopsinids (see, *e.g.*, detailed studies of Emberton, 1988), they are unusual enough as to justify generic separation, as has been done recently in the related western genera *Vespericola* and *Hochbergellus* (Roth & Miller, 1992, 1993). Two other Snake River forms (*Cryptomastix* (*Bupiogona*) n. sp. 1 and n. sp. 2 above) are similar in gross anatomy, but differ considerably and consistently in shell and soft part details. For anatomy of typical *Cryptomastix* (*s.s.*), see Pilsbry (1940) and Webb (1970a).

**Discussion:** As noted above, it may be necessary to designate a new type species for *Bupiogona*, according to ICZN rules. However, this will not affect the status of this species, the logical choice for neogenotype. To resolve the situation it will be necessary to establish the nature of Webb's specimens and request a ruling under Articles 65B, 67I, and 70 (ICZN, 1985). Note that available courses of action do not affect the validity of either *Cryptomastix hendersoni* or *Cryptomastix populi.*

This species was cited in the same manner in Frest & Johannes (1995a, b).

**Ecology:** This taxon, a moderate xerophile, is found mostly in rather open and dry, large-scale basalt taluses, generally at lower elevations, along a limited portion of the northern Hells Canyon (Snake River) drainage, Idaho, Washington, & Oregon, the Lewiston and Clarkston area, Idaho & Washington, and the lowermost few miles of the lower Salmon River Canyon, Nez Perce County, Idaho. The rather limited talus vegetation may include *Celtus*, *Artemisia*, *Prunus*, *Balsamorrhiza*, grasses, *Seligeria*, and some bryophytes. Surrounding vegetation is generally sage scrub. This species usually occurs in steep, north or east-facing taluses, often only at their base. It is a xerophile as compared to most other *Cryptomastix* species, but avoids the most dry sites, *i.e.*, areas preferred by *Oreohelix haydeni* subspp. and *Oreohelix idahoensis*. Common land snail associates include *Cryptomastix* (*Cryptomastix*) n. sp. 2 and 3, *Allogona ptychophora ptychophora*, *Allogona ptychophora solida*, and various species of *Oreohelix*. This taxon has been found occasionally in metasedimentary taluses as well.

**Original distribution:** Probably once comparatively frequent in the areas underlain by the Grande Ronde and Columbia River basalts, Snake River, lower Salmon River, and lower Clearwater River. Most colonies occur at slope bases along the major river corridors, not in major tributaries.

**Current distribution:** This taxon now occurs as isolated colonies in relatively undisturbed portions of the original distribution, *i.e.*, roadless areas in the lower Salmon River canyon and northern Hells Canyon. It is replaced by related species in the central and southern parts of Hells Canyon. Clearwater sites appear to be extirpated. Much or all of the known and potential range has recently been surveyed in some detail (Frest & Johannes, 1995b). The current range is largely, but not wholly, coincident with that of *Allogona ptychophora solida*: the latter does not appear to range down the Snake as far as Clarkston, Washington.

Several years ago, we believed this taxon to be much more widespread; but further collecting and elimination of certain sites within a few years of our first visits in the late 1980s has made us much less sanguine about chances for the species' survival.

For further information and map of lower Salmon River sites, see Frest & Johannes (1995b).

**Idaho distribution and comments:** Most of this taxon's limited distribution is in Idaho, along the lowermost lower Salmon River and a very small part of Hells Canyon.

**Specific Idaho sites:** LSR 87-90, 125, 149, 157, 158, 159, 160: 10 sites. Note that these sites are rather scattered, mostly limited to basalt talus occurrences.

**Threats:** Grazing is extensive in much of the original habitat, and the species appears to be absent from heavily grazed areas. The former colony at Lime Hill, near Rogersburg, Washington, *e.g.*, seems to be extirpated solely due to grazing. Roads are often located preferentially along the bases of large talus piles in the larger river corridors inhabited by the species, *e.g.*, US 95; roadside spraying is a problem for some colonies. Mining of basalt for road metal and for fill has extirpated colonies since 1990, *e.g.*, near White Bird and Lewiston, Idaho. Very large colonies along US 12 west of Clarkston have been extirpated by road realignment and maintenance in the last few years.

**Criteria for inclusion:** A local endemic that has lost much of its rather specialized habitat. Remaining colonies are mostly on public lands, including BLM and Nez Perce National Forest properties. Very few sites known or likely. This species is declining throughout its limited range, and colony loss has been observed in recent years.

**Recommended status:** Has none at present, but minimally should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Washington, Oregon, Idaho) listing as Threatened is warranted, due to loss of habitat and increasing human populations and usage of most or all of remaining habitat.

**References:** Vanatta (1924); Pilsbry (1940); Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Cryptomastix* (*Cryptomastix*) *harfordiana* (Binney, 1878)
### Salmon oregonian

**Type locality:** Salmon River (Hemphill); Pilsbry (1940, p. 870) states "probably somewhere north of Lucile", Idaho County, Idaho (lower Salmon River drainage). Holotype ANSP 11116.

**Description:** A small taxon (to 13 mm); spire strongly depressed; diameter about 13 mm; color light brown; aperture slightly inclined; lip narrow, moderately tridentate, white, not L-shaped in side view, palatal lamella relatively strong; lip moderately revolute except basally; shell very sparsely hirsute, with adults often lacking any periostracal setae; whorls 4 1/2-5, fairly rapidly expanding.

**Discussion:** The tangled history of the name as applied to Salmon River snails has been well reviewed by Pilsbry (1940), which work also has the best previous illustration and description of the shell. See also Frest & Johannes (1995b), who more carefully distinguish this taxon from other closely related species. Also, consult key 1P (**APPENDIX A**) for comparisons with similar taxa. Live-collected specimens are generally very sparsely hirsute; dead shells almost always lack setae. Because of confusion with other species, this taxon's classification was considered uncertain in Turgeon (1988). Dissection confirms the generic ascription.

**Ecology:** This species is most often found in rock taluses (limestone, schist; more rarely basalt or granite) at low elevations. Most are comparatively dry and open, with scattered *Celtus*, grasses, and *Rhus* clumps. On occasion, the species is found in open to more sheltered stream side boulder piles, often with *Salix*, *Cornus stolonifera*,

*Rubrus*, and bryophyte cover in part. Common associates include several species of *Oreohelix*, including *idahoensis idahoensis*, *jugalis*, and *waltoni*, plus *Allogona ptychophora*, *Helicodiscus salmonaceus*, *Vitrina alaskana*, and *Vallonia cyclophorella*. The species can occur in relatively strongly xeric sites, such as sage scrub; but it is usually rare in such settings; it is basically a moderate xerophile.

**Original distribution:** Lower Salmon River valley between Riggins and Copperville, Idaho County, Idaho. This species was probably extremely abundant originally in its narrow area of occurrence, and is still often the dominant species of *Cryptomastix* locally.

**Current distribution:** Scattered sites within the original area of distribution. We have recently surveyed this area in some detail (Frest & Johannes, 1995b). For site details and map, see Frest & Johannes (1995b). As many other malacologists and collectors, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton, have explored this area, it is unlikely that the range or number of sites will be significantly expanded by future work.

**Idaho distribution and comments:** See above; another strict Idaho endemic limited to a small part of the lower Salmon river corridor. Judging by the range of environments occupied, the original distribution may have essentially been one long continuous colony between Riggins and Copperville along the lower Salmon River corridor. The range is much more fragmented now.

**Specific Idaho sites:** LSR 4-6, 35, 39, 40, 41, 106, 107, 108, 130, 131, 132, 136, 143, 165, 173, 187: about 18 live sites. Other extinct colonies are known. Note logic given above concerning site numbers.

**Threats:** Grazing over whole of range; talus mining and removal; gold and gravel mining operations; road building (*e.g.*, US 95 corridor, which traverses roughly 50% of total range); human habitation; roadside spraying. The species tends to occur at the base of major slopes, which are also primary road and human habitation and recreation sites.

**Criteria for inclusion:** Loss of historic habitat; loss of colonies in recent years (declining number of sites and individuals); continuing heavy grazing in whole range; occurrence on public lands, including BLM and Nez Perce National Forest property; expanding recreational use of Salmon River corridor. The trends for the population as a whole (number of sites, number of individuals) are downward.

**Recommended status:** Currently has none. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Endangered should be considered, as suggested previously in Frest & Johannes (1995a, b): the species is a local endemic with a very limited distribution. Preferred habitat is limited in occurrence and especially subject to human utilization. The species occurs partly on public lands.

**References:** Pilsbry (1940); Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

### *Cryptomastix* (*Cryptomastix*) *magnidentata* (Pilsbry, 1940)
### Mission Creek oregonian

**Type locality:** Mission Creek, 7-8 mi. above Jacques Spur, Nez Perce County, Nez Perce Reservation, Idaho. Holotype ANSP 171243.

**Description:** See Pilsbry (1940) and Webb (1970b). Another illustration is on the cover of Frest & Johannes (1995a). Full species status dates from Webb (1970b) and is accepted in Turgeon *et al.* (1988; 1998). Spire comparatively convex, depressed conic; lip white, scarcely revolute, with three rather strong lamellae; umbilicus partly covered Lamellae very strongly developed, especially parietal; aperture largely closed; shell sparsely hirsute; brown; 4 1/2-5 1/2 whorls.

**Discussion:** Live-collected specimens are consistently sparsely hirsute, with individual periostracal hairs relatively prominent and moderately broad-based. *C. sanburni* has closer whorls; and mature specimens have one additional whorl. This species most closely resembles two undescribed taxa from the north Hells Canyon area: for comparisons, see Frest & Johannes (1995a) and entry for *Cryptomastix* n. sp. 2 below. See also keys P, R (**APPENDIX A**).

**Ecology:** The species lives in moist, rocky, well-shaded *Pinus* forest with common forbs and deciduous trees, and in moist and mossy, rather open grassy limestone and mixed limestone-basalt taluses a short distance above the flood plain of Mission Creek. Common associates are *Allogona ptychophora solida* and *Polygyrella polygyrella*. A weakly mesophile species.

**Original distribution:** So far known only from the vicinity of the type locality. Attempts in 1991 and 1994 to find other sites in the immediate area and along the nearer portions of the Clearwater River and some major tributaries were unsuccessful. We also have not found this taxon in the lower Salmon River drainage (Frest & Johannes, 1995b) or in Hells Canyon. Drought has also affected much of the talus area, such that most now has dead shells only. Specimens from the vicinity of Kooskia placed in this taxon by Smith (1943) are *Cryptomastix* n. sp. 1 (Lochsa oregonian). It is unlikely that the range or number of sites will be significantly expanded by future work.

**Current distribution:** Scattered colonies along a half-mile stretch of Mission Creek (one side only). Most colonies are on the Nez Perce Reservation. Others may be on adjoining State of Idaho lands.

**Idaho distribution and comments:** Once again, a strict Idaho endemic, limited likely to a single limestone accreted terrain block; and then only to creek corridor portions of that block.

**Specific Idaho sites:** Only one known to survive, the type locality. We discussed the location of the colony and conservation possibilities with tribal representatives, who responded positively, in 1996.

**Threats:** Much of the type area has been greatly modified due to limestone quarrying, which has proceeded sporadically for many years and is ongoing. Sites are along the present quarry haul road, which has impacted taluses in the area substantially. The valley of Mission Creek is heavily used just downstream for agriculture and pasturing, and portions of the quarry area have also been heavily grazed. Much of the upland in the immediate vicinity has been logged. The species is absent from these areas, and is evidently declining in numbers and area occupied. Population trends (condition of site, number of individuals) are downward.

**Criteria for inclusion:** Extremely local endemic; past and current threats in only known area of occurrence; declining trend evident; association with forest and riparian zone.

**Recommended status:** Until recently a Federal (Category 2) candidate (USFWS, 1994). There is sufficient recently-collected information, and recent survey work, to indicate that should be listed as Endangered Federally and in Idaho, as stated previously in Frest & Johannes (1995a). Should be considered a Sensitive species by the Forest Service, BLM, Nez Perce Tribe, and other appropriate land and wildlife management agencies.

**References:** Pilsbry (1940); Webb (1970b); USFWS (1994); Frest & Johannes (1995a); Deixis collections, 1991-1994.

### *Cryptomastix* (*Cryptomastix*) *mullani blandi* (Hemphill, 1892)
### Bland oregonian

**Type locality:** Post Falls, Kootenai County, Idaho (Hemphill); syntypes CAS 58841, 58842; paratypes ANSP 62304, according to Baker (1964). See Coan & Roth (1987) for CAS types.

**Description:** The best description and illustrations are those of Pilsbry (1940), *q.v.*; see also key 1R (**APPENDIX A**). Spire nearly flat; shell scarcely or not at all hirsute; color brown-reddish-brown; umbilicus partly covered; lip narrow, revolute, white; with two lamellae: small nodular parietal and small, tooth-like basal; no palatal. Shell diameter about 12-15 mm.

**Discussion:** The rather large, only partly covered umbilicus; two lamellae; and narrow lip are distinctive. Most other northern Idaho species have much more convex spires and a wide apertural lip with three lamellae.

**Ecology:** Lower elevations in river valleys with relatively undisturbed, perennially wet coniferous forest with a strong deciduous understory. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. A mesophile species.

**Original distribution:** Known with certainty only from a limited area in the Coeur d'Alene River valley in the vicinity of Post Falls and Coeur d'Alene, Idaho. We examined specimens from near Lake Como, Ravalli County, Montana, in ANSP collections ascribed to this subspecies by Pilsbry (1940) and believe that they are aberrant *Cryptomastix mullani mullani*. No Montana specimens are in the extensive collections of R. B. Brunson.

**Current distribution:** Collected in the vicinity of Coeur d'Alene by us in 1990; 1994 revisits to the site and others in the vicinity produced no live specimens. Attempts in recent years by private collectors to find this species have also been unsuccessful (S. Welty, pers. comm., 1994). It is unlikely that the range or number of sites will be significantly expanded by future work.

**Threats:** Most of potential habitat area has been logged; some is being heavily grazed; and much has been affected by past mining and smelting activities. Both Post Falls and Coeur d'Alene and the intervening corridor have been urbanizing rapidly in recent years.

**Idaho distribution and comments:** Despite proximity to Washington, old sites are known only from Idaho; and this appears to be a strict Coeur d'Alene corridor endemic.

**Specific Idaho sites:** Historic literature sites are vague; but we believe that there were 3 sites originally, as mentioned above. We have still not recollected this taxon; it could be extinct.

**Criteria for inclusion:** Very local endemic, evidently in decline; past and current human activities in habitat; habitat loss, past and ongoing. Population trends (number of sites, number of individuals) are evidently downward.

**Recommended status:** Has none at present. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Endangered should be considered, due to habitat loss, local endemic status, and decline in historic populations. The same recommendation was made previously (Frest & Johannes, 1995a).

**References:** Pilsbry (1940); Frest & Johannes (1995a); Deixis collections, 1990, 1994.

### *Cryptomastix* (*Cryptomastix*) *mullani clappi* (Hemphill, 1897)
### River of No Return oregonian

**Type locality:** "Salmon River Mountains" (Hemphill); syntypes CAS 58821; ANSP 71479 [paratypes according to Baker (1964); possible syntypes according to Coan & Roth (1987)]; USNM 46905, 58754. As usual, Hemphill's locality citation is vague. The types likely came from the River of No Return area, east of Riggins and west of French Creek, Idaho.

**Description:** See Pilsbry (1940) and Frest & Johannes (1995a, b) for complete description and illustrations. Shell about 15-17 mm in diameter; spire low subdiscoidal; adults distinctly hirsute, with close, very short setae; color dark brown; body black; umbilicus relatively large, open. Apertural lip weakly tridentate, narrow, white.

**Discussion:** The dark body color, medium size, low subdiscoidal conch, and fine, dense pelage distinguish the form (actually a full species) from related taxa. All localities are restricted to a rather small part of the west side of the River of No Return valley (see map in Frest & Johannes, 1995b). In this area, it is often the only *Cryptomastix*. See key 1R (**APPENDIX A**) for further comparisons with co-occurring or nearby taxa.

**Ecology:** Found mostly at lower elevations in forested areas (mostly partly open *Pinus ponderosa* forest), on moist, north-facing slopes. Occasionally common in extensive mossy, north-facing metasedimentary taluses. Most sites have rich understory floras, including grasses, bryophytes, forbs, and shrubs. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. See Frest & Johannes (1995a, b) for further discussion. A mesophile species.

**Original distribution:** Confined to a narrow area on the south side of the River of No Return between Riggins and the mouth of French Creek, with a few isolated occurrences along the main Salmon from Riggins to Lucile, Idaho. Specimens ascribed to White Bird and to Slate Creek (Henderson in Pilsbry, 1939) are another taxon.

**Current distribution:** A few isolated colonies in the area cited above. This region was extensively surveyed in 1993-1994 (see Frest & Johannes, 1995b, for site map). Many other collectors, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton, have explored this area. It is unlikely that the range or number of sites will be significantly expanded by future work.

**Idaho distribution and comments:** Another lower Salmon River corridor endemic, this time limited to the western part of the River of No Return area, mostly on the south side of the river.

**Specific Idaho sites:** LSR 17-22, 24-26, 192-194, 211; about 10 live sites. As with some other taxa, note that, prior to disturbance, this taxon seems robust enough to have occupied an almost continuous band in its now fragmented range.

**Threats:** Gold mining and road building (*e.g.*, US 95, French Creek Road) in narrow area occupied; talus removal; logging; major fires in 1994. This form is evidently declining; extinct colonies were noted in 1993-1994, and habitat modification is extensive. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Very local endemic; decline in absolute numbers and number of sites; continued human activities in preferred habitat; habitat loss; association with relatively intact forest; occurrence on public lands (BLM, Payette and Nez Perce National Forests).

**Recommended status:** This taxon has none at present: it should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Endangered is warranted. Note that the same recommendation was made in Frest & Johannes, 1995a, b). Many of the known sites have been negatively affected by grazing, logging, and other activities. The effects of the 1994 fires have not been evaluated but are predictably negative, especially in areas affected by other activities.

**References:** Pilsbry (1940); Frest & Johannes (1995a, b); Deixis collections, 1989-1891, 1993, 1994.

### *Cryptomastix* (*Cryptomastix*) *mullani latilabris* (Pilsbry, 1940)
### wide-lipped oregonian

**Type locality:** Lower two or three miles of John Day Creek, lower Salmon River drainage, Idaho County, Idaho; holotype ANSP 175777a. According to Frest & Johannes (1995a, b), this species is extinct in the lower John Day Creek drainage but survives farther upstream.

**Description:** See Pilsbry (1940) and Frest & Johannes (1995a, b). Shell moderate-sized, about 10-13 mm in diameter; color yellowish red; apertural lip broad, white; nonrevolute; weakly tridentate; shell depressed conic; with short and sparse but persistent setae. Also consult key 1P (**APPENDIX A**) for comparisons with several other area taxa.

**Discussion:** The small size; relatively flat spire; wide white lip; and details of the apertural lamellae distinguish this taxon from other Lower Salmon River valley species.

**Ecology:** Found in moist and shady areas in relatively intact forest, generally on limestone substrate; occasionally in shaded and mossy limestone and schist talus, at moderate elevations, mostly near stream borders. Forest is *Pinus ponderosa* with strong forb and deciduous shrub understory, including *Pyrola* spp., *Cornus canadensis*, *Linnaea borealis*, *Viola* spp., and rich litter. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. Associated land snails include *Oreohelix* n. sp. 22 (Slate Creek mountainsnail), *Oreohelix haydeni hesperia*, *Discus marmorensis*, *Anguispira kochi occidentalis*, *Allogona* sp. cf. *lombardii*, *Hemphillia* sp. cf. *camelus*, *Pristiloma subrupicola*, and *Pristiloma idahoensis*. A mesophile, as are most *Cryptomastix* species.

**Original distribution:** Probably confined to rich forest at moderate to high elevations along a portion of the lower Salmon River, Idaho County, Idaho. Pilsbry (1940) ascribes specimens from a site along the South Fork Clearwater River 3-4 mi. below Harpster to this species; but examination of the specimens indicates they are better assigned to *mullani mullani*. We revisited this site in 1991.

**Current distribution:** Found in remnant colonies along two major creeks tributary to the central lower Salmon River, Idaho County, Idaho; see Frest & Johannes (1995a, b) for details and site map. The species is extinct at the type locality, and also at the old site in sec. 35, T 26 N R 1 E, near Lucile. The species is absent from heavily grazed and clear-cut areas, such as lower John Day Creek. The area of occurrence was surveyed for land snails in 1993-1994 (Frest & Johannes, 1995a, b); and many other collectors, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton, have explored this area. It is unlikely that the range or number of sites will be significantly expanded by future work.

**Idaho distribution and comments:** Another strict Idaho endemic, found only in a small portion of the lower Salmon drainage, essentially along one side of a single accreted terrain limestone block

**Specific Idaho sites:** Just 4 known to persist: LSR 43, 46, 47, 185. Note that some historic sites are now extirpated; and that disturbance has demonstrably reduced the range, even though the range was originally small

**Threats:** Limestone quarrying, past and present; lumbering in most of known and potential habitat; road building along critical stream corridor; heavy grazing in much of lumbered habitat.

**Criteria for inclusion:** Local endemic; loss of habitat; ongoing threats; occurrence on public lands, including BLM and Nez Perce National Forest parcels; loss of historic sites, including the type locality. The species is definitely declining. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Has none at present: it should be considered a Sensitive species by the Forest Service and BLM. Federal and State (Idaho) listing as Endangered is justified on current information, due to loss of historic sites and degradation of most of known and likely habitat: see above and Frest & Johannes (1995a, b).

**References:** Pilsbry (1940); Frest & Johannes (1995a, b); Deixis collections, 1989-1991, 1993, 1994.

### *Cryptomastix* (*Cryptomastix*) *mullani tuckeri* (Pilsbry & Henderson, 1930)
### scaled oregonian

**Type locality:** On the Clearwater River near the mouth of Fourth of July Creek, Clearwater County, Idaho; holotype UCM 17001a; paratypes UCM 17001b, c, ANSP 152334. See Wu & Brandauer (1982) for UCM types.

**Description:** See Pilsbry & Henderson (1930, 1931a); Pilsbry (1940) for description and illustration. Hairs scale-like; umbilicus partly covered; spire very low convex; shell diameter about 13 mm; lip light brown; width moderate; lamellae usually one or two: small or no parietal; narrow basal; no palatal. For regional comparisons, reference **APPENDIX A**, key 1R.

**Discussion:** The low spire and scale-like hairs are very distinctive features. So far, this is the only *Cryptomastix* species with such periostracal setae to be noted.

**Ecology:** Very moist, relatively undisturbed *Pinus ponderosa* forest with a rich forb and deciduous shrub understory, along a major river corridor and at relatively low elevations, generally at the base of steep slopes with exposed bedrock. Moist valley, ravine, gorge, or talus sites are seemingly preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture appears to be a *desideratum*. Associated land snails include *Anguispira nimapuna*, *Anguispira kochi occidentalis*, other *Cryptomastix* species, *Allogona lombardii* and *Allogona ptychophora ptychophora*. A mesophile species.

**Original distribution:** Along a portion of the mainstem Clearwater River, from Orofino to Kooskia, Clearwater, Idaho, and Nez Perce counties, Idaho.

**Current distribution:** Uncertain; the species appears to be extinct in the Orofino area and near the mouth of Fourth of July Creek (checked in 1991, 1993, 1994). Probably survives rarely within original range. It is unlikely that the range or number of sites will be significantly expanded by future work.

**Idaho distribution and comments:** An Idaho endemic, apparently limited to a portion of the lower Clearwater River corridor.

**Specific Idaho sites:** Old sites numbered at least two, but were vague (see above). Visits to these areas have proven unproductive thus far.

**Threats:** Occurs mostly along a major highway (US 12) that has already much reduced available habitat. Much of historic range has been logged or may be in the immediate future; mining and ore refining near Orofino has much reduced local land snail populations; human habitation and activities are concentrated in its narrow range of occurrence.

**Criteria for inclusion:** Association with relatively intact forest and riparian corridor; occurrence on public lands, including Clearwater National Forest; loss of historic sites and habitat (the species is declining); very local endemic. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This taxon currently has none. It should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Endangered should be considered, as earlier suggested by Frest & Johannes (1995a), due to decline in number of historic sites, loss of habitat, and ongoing threats.

**References:** Pilsbry & Henderson (1930, 1931); Pilsbry (1940); Frest & Johannes (1995a).

***Cryptomastix* (*Cryptomastix*) n. sp. 1**
**Lochsa oregonian**

**Type locality:** None designated as yet; undescribed taxon.

**Description:** A small species (diameter to 11 mm) with 4 1/2 relatively rapidly expanding whorls; spire depressed, low convex; umbilicus small but distinct, about 1/10 full shell diameter; color cinnamon red; adult strongly hirsute with closely spaced and fine periostracal hairs. Aperture brown, three-lobed, with well-developed white basal, parietal, and columellar teeth; lip comparatively narrow, slightly revolute, no more so on base. Columellar insertion just above midpoint of umbilicus, lip slightly reflected over umbilicus.

**Discussion:** This species is related to *Cryptomastix magnidentata* and *Cryptomastix sanburni*. Both of these are much larger, brown in color, and much more sparsely hirsute. This species has a much lower spire and fewer whorls than *sanburni*; details of the aperture and tooth arrangement, as well as size, color, and pelage, distinguish it from *magnidentata*. For example, both of these species have stronger (wider) white lips and more prominent apertural denticles (teeth). Neither is as strongly hirsute as this species; both are much larger and more dome-shaped. For differences from the Hells Canyon-lower Salmon River tridentate species, see Frest & Johannes (1995a) and below. For more local comparisons, perusal of key 1P (**APPENDIX A**) may be helpful. This taxon is listed under the same name in Frest & Johannes (1995a).

**Ecology:** Found in moist, well-shaded, *Pinus ponderosa* forests at moderate elevations, generally associated with springs and seeps; forbs and deciduous shrubs common; soil thin, often rocky; metasedimentary and limestone lithologies predominant as the regolith. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. A mesophile species.

**Original distribution:** Portion of Lochsa River and uppermost Clearwater River corridor, between Kooskia and Powell, Clearwater County, Idaho. This taxon was reported as *Cryptomastix mullani magnidentata* by Smith (1943).

**Current distribution:** This species appears to be confined to a few colonies in relatively pristine forests along a part of the Lochsa River. It may occur in adjoining portions of Idaho County as well; but searches there thus far have been unsuccessful. It is unlikely that the range or number of sites will be significantly expanded by future work. Sites include ones on Clearwater National Forest lands.

**Idaho distribution and comments:** A strict Idaho precinctive, confined to a narrow portion of the lowermost Lochsa River corridor and a few miles of immediately adjacent Clearwater River corridor.

**Specific Idaho sites:** We have noted the species live from about 4 sites.

**Threats:** Lumbering and major fires have occurred through much of the potential habitat; road building is an ongoing problem; grazing is extensive in portions of the habitat; roadside spraying is a problem for some colonies. The species seems to be absent from areas affected by one or a combination of the above factors.

**Criteria for inclusion:** Local endemic; habitat loss and resulting decline in range and numbers; association with relatively pristine slope and riparian forest; occurrence on public lands, including Clearwater National Forest and Lochsa portion of Clearwater Wild and Scenic River corridor. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Currently, has none. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho) listing as Endangered is warranted, due to road usage, lumbering and grazing, fires, very limited number of known and likely sites. The same recommendation was made in Frest & Johannes (1995a).

**References:** Frest & Johannes (1995a); Deixis collections, 1989-1994.

### *Cryptomastix* (*Cryptomastix*) n. sp. 2
### Hells Canyon oregonian

**Type locality:** None designated as yet; undescribed taxon.

**Description:** A medium-sized *Cryptomastix* species (diameter to 13 mm) with 4 1/2 relatively rapidly expanding whorls; spire slightly dome-shaped, convex; umbilicus narrow but distinct, about 1/9 full shell diameter; color medium-dark brown; adult not at all hirsute. Aperture white, three-lobed, with well-developed basal, parietal, and columellar teeth; lip white, moderately thick, strongly revolute all around, including base; columellar insertion at midpoint of umbilicus (above), covering perhaps 1/3 of umbilicus.

**Discussion:** This species, cited here as in Frest & Johannes (1995a), is related to *Cryptomastix magnidentata*; but that taxon is hirsute, smaller, has a more strongly domed spire, and the apertural lip is not strongly revolute. Details of the apertural dentition differ also. This taxon also somewhat resembles *Cryptomastix sanburni*, but the higher, dome-shaped spire, larger number of closely-spaced whorls, and smaller umbilicus of that species are obvious differences. Comparisons with other similar taxa are made in **APPENDIX A** (key 1P: see also key 1R for *sanburni*).

**Ecology:** A strong xerophile species, generally found in open, dry basalt taluses with sparse vegetational cover (rare *Celtus*; sparse grasses; clumps of *Rhus horribilis*). Frequent land snail associates are *Oreohelix* n. sp. 27 (Hells Canyon mountainsnail), *Cryptomastix populi*, and *Cryptomastix* n. sp. 3 (disc oregonian).

**Original distribution:** Northern portion of Hells Canyon (Snake River) and the mouth of the Grande Ronde River, *i.e.*, from south of Lewiston to the mouth of China Garden Creek, Asotin County, Washington, Nez Perce County, Idaho, and possibly Wallowa County, Oregon. This area includes portions of Wallowa-Whitman and Nez Perce National Forests.

**Current distribution:** Known live from less than 5 colonies in the area cited above. We have collected this area in the period from 1988-1992. Sites have also been collected recently by T. Burke (Wenatchee National Forest). It is unlikely that the range or number of sites will be significantly expanded by future work.

**Idaho distribution and comments:** There are less than a half dozen live sites altogether. Most of these are in Asotin County, Washington. This is a northern Hells Canyon endemic.

**Specific Idaho sites:** We are aware of one live site in Nez Perce County, Idaho.

**Threats:** Talus mining and road building; grazing in preferred habitat; roadside spraying. Extinct colonies have been noted in mined taluses in this area; the species is declining. Population trends (number of sites, number of individuals) are believed to be clearly downward.

**Criteria for inclusion:** Very local endemic; small number of known and potential sites; specialized habitat; occurrence on public lands, including Hells Canyon National Scenic Area.

**Recommended status:** Thus far, has none: it should be considered a Sensitive species by the Forest Service and BLM. As originally suggested in Frest & Johannes (1995a), there is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho, Washington) listing as Endangered is appropriate, due to small number of sites, habitat loss, etc.; see above. Status of this species in Oregon is uncertain at the moment; more survey work is needed there.

**References:** Frest & Johannes (1995a); Deixis collections, 1989-1992; 1994.

### *Cryptomastix* (*Cryptomastix*) n. sp. 3
### disc oregonian

**Type locality:** None as yet; undescribed taxon.

**Description:** This small *Cryptomastix* species has a nearly flat spire of 5 1/2 rather closely spaced whorls. Maximum adult size is about 10 mm; but most adults average about 8 mm. The species lacks periostracal hair; is light yellow in color; and has a white, strongly tridentate aperture. The aperture is narrow, strongly inclined, strongly constricted immediately behind the lip, and has a prominent indentation in the area of the parietal tooth, causing the lip to appear L-shaped in side view. Most animals have the mantle lightly spotted with black, although 3 colonies in the vicinity of Lyons Bar consistently have darker mantles. The umbilicus elliptical and comparatively broad, *ca.* 1/4 the full shell diameter in width. The lip is rather narrow, non revolute; the columellar insertion is mostly to the right of the umbilicus, which has only a small proportion covered by it. The shell base is comparatively flat.

**Discussion:** This species can be distinguished from most related taxa by the color and flat, disc-like spire. Only the much-larger and quite distinct *Cryptomastix sanburni* has equally slowly expanding whorls. The L-shaped apertural lip is also quite distinctive. Perusal of key 1P (**APPENDIX A**) may also be useful. Cited identically in Frest & Johannes (1995a, b).

**Ecology:** A strong xerophile. This species prefers dry, exposed taluses, most frequently basalt. Cover is limited to grasses, uncommon *Seligeria* and mosses, scattered *Rhus horribilis* or *Sorbus* clumps and occasional *Celtus* and *Prunus*. Commonly co-occurring land snails are *Cryptomastix populi*, *Allogona ptychophora solida*, *Allogona ptychophora ptychophora*, and several *Oreohelix* species, most often *jugalis* or *vortex*.

**Original distribution:** Limited to a portion of the lower Salmon River, Nez Perce and Idaho counties, Idaho, from approximately the mouth of White Bird Creek to the confluence with the Snake River in Hells Canyon, thence downstream in the Snake (Nez Perce County, Idaho; Wallowa County, Oregon, and Asotin County, Washington) to a point a few miles west of Clarkston, Washington. See Frest & Johannes (1995b) for further details.

**Current distribution:** Found in very small numbers in a small number of colonies in the region cited above. The lower Salmon River area was surveyed comprehensively by us recently (Frest & Johannes, 1995b: *q.v.* for site details and map); we have collected the north part of Hells Canyon and the Snake River in Washington in the period 1989-1994. The Snake River corridor near Clarkston has also been collected recently by T. Burke (Wenatchee National Forest) and W. B. Miller (Santa Barbara Museum of Natural History). It is unlikely that many additional sites will be found.

**Idaho distribution and comments:** This taxon has a somewhat similar distribution to the last (*C.* n. sp. 2); and, like it, occurs a bit more widely in Washington. However, there is a definite presence in the lowermost part of the lower Salmon River corridor and immediately adjoining parts of Hells canyon.

**Specific Idaho sites:** Of the dozen known live sites altogether, 7 are in Idaho: LSR 83, 86, 147, 159, 161, 162, 191.

**Threats:** Essentially all of the Salmon River habitat is grazed, much heavily; as is much of the Hells Canyon area. As with other species in this region, highway corridors are located along some of the suitable habitat, *e.g.*, US 12 in Washington. Talus mining and roadside spraying are problems for some colonies, particularly in the Washington portion of the range. Some sites west of Clarkston and south of Lewiston collected in the late 1980s have been

extirpated by road modification in the last three years; the species is declining in numbers and areal extent. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Local endemic; specialized and limited habitat; small number of known and potential sites; loss of historic sites; occurrence on public lands, including Hells Canyon National Recreation Area.

**Recommended status**: A newly recognized form with no status as yet. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Idaho, Washington, Oregon) listing as Endangered is warranted, due to habitat loss and decrease in historic sites, ongoing threats.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

### *Cryptomastix* (*Cryptomastix*) n. sp. 5
### Lucile oregonian

**Type locality:** None as yet; undescribed taxon.

**Description:** This medium-sized *Cryptomastix* species has a low spire of 4 1/2–5 whorls, moderately rapidly expanding. Maximum adult size is about 16 mm, larger than *harfordiana* and roughly the same as *clappi*; but most adults average about 14 mm. The species often lacks periostracal hair or has only traces (unlike *clappi*, which is distinctly and closely hirsute; or *harfordiana*, which generally lacks periostracal hair); color ranges from bluish gray to tan; and has a white, weakly tridentate aperture. The aperture is comparatively broad, weakly inclined, and has a whitish periphery, with the basal lamella and palatal tooth present but always weak. The parietal tooth is more distinct than that of *clappi*; but much less prominent than that of *harfordiana*. The umbilicus is similar in morphology to that of *clappi*. Most animals have the mantle lightly spotted with black. The lip is rather narrow, weakly revolute, broader than that of *clappi*; the columellar insertion is definitely above the umbilicus, which has a small proportion covered by it, similar to *harfordiana* and less open than that of *clappi*. The shell base is low convex.

**Discussion:** This species is present in older collections from the Lucile area. Pilsbry (1940, p. 869, text and fig. 504 b-d) described and illustrated it as "form intermediate between *clappi* and *harfordiana*" - an apt definition on shell morphology. With sizable quantities of live material of all three, the distinctness of this form becomes apparent. Comparisons with *clappi* and *harfordiana* have been made above; see also discussion of *Cryptomastix* n. sp. 6 below and key 1P (**APPENDIX A**). We cited this taxon identically previously (Frest & Johannes, 1995a, b).

**Ecology:** A moderate xerophile. This species prefers exposed taluses of varying lithology, including schist and limestone. Cover is often limited to grasses, uncommon *Seligeria* and mosses, scattered *Rhus horribilis* or *Sorbus* clumps and frequent *Celtus* and *Prunus*. Commonly co-occurring land snails are *Allogona ptychophora ptychophora* and several *Oreohelix* species, most often *idahoensis idahoensis* or *jugalis*.

**Original distribution:** A strict local endemic, limited to a portion of the Lower Salmon River valley, Idaho County, ID, from approximately Riggins to the mouth of White Bird Creek (see Frest & Johannes, 1995b, **APPENDIX** C16). Almost all sites are in or very near to the valley of the mainstem Lower Salmon River.

**Current distribution:** This *Cryptomastix* is locally common, being found at about 40 sites within its rather restricted total distribution, confined to a limited area of the main Salmon River corridor. Several of these sites may no longer represent living populations; and the taxon is rare live at most sites. It is unlikely that many additional sites will be found. See map and supporting documentation in Frest & Johannes (1995b).

**Idaho distribution and comments:** This is the next taxon downstream from *Cryptomastix harfordiana* in the lower Salmon River corridor and overlaps in part with it in distribution. Like that species, that is a fairly tolerant taxon

that probably once was continuous in distribution in its limited range; and is also a strict Idaho precinctive. That range is now much fragmented.

**Specific Idaho sites:** LSR 1-3, 7-11, 15, 33, 37, 38, 52, 54, 59, 67-70, 75, 91, 97, 100, 101, 109, 118, 120, 121, 128, 129, 133, 134, 150, 174, 188, 195; about 36 live sites, but note provisos cited above. Extinct colonies have been noted also.

**Threats:** Essentially all of the Salmon River corridor is grazed, much heavily. As with other species in this region, highway corridors are located along some of the suitable habitat, in particular US 95. Talus mining and roadside spraying are problems for some colonies. Gold mining has impacted (and likely extirpated) some sites. Certain localities collected in the late 1980s have been extirpated by road modification in the last three years. Grazing has much reduced some sites, leading to extinction or near extinction of sites in the Lucile and Twilegar Gulch areas within the last 5 years. The species is declining in numbers and areal extent. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Strict local endemic; specialized and limited habitat and distribution; loss of historic sites; occurrence on public lands, including BLM tracts.

**Recommended status**: A newly recognized form with no status as yet. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (ID) listing as Threatened is warranted (as suggested in Frest & Johannes, 1995a, b), due to habitat loss and decrease in historic sites, ongoing threats.

We regard this species as common in the part of the survey area in which it occurs: but the total range is small and unfortunately concentrated in that part of the Lower Salmon River corridor most susceptible to human modification.

**References:** Deixis collections, 1989-1994; Frest & Johannes (1995a, b).

### *Cryptomastix* (*Cryptomastix*) n. sp. 6
### White Bird oregonian

**Type locality:** None as yet; undescribed taxon.

**Description:** This medium-sized *Cryptomastix* species has a low spire of 4 1/2-5 whorls, moderately rapidly expanding. Maximum adult size is about 16 mm, larger than *Cryptomastix harfordiana* and roughly the same as *clappi*; but most adults average about 14 mm. The species often lacks periostracal hair or has only traces (unlike *clappi*, which is distinctly and closely hirsute; or *harfordiana*, which generally lacks periostracal hair); color is generally bluish gray; and has a white, very weakly tridentate aperture, often with the palatal lamella absent. The aperture is comparatively narrow, weakly inclined, and has a whitish periphery, with the basal lamella and palatal tooth present but nearly vestigial. The parietal tooth morphology is much like that of *clappi* and much less prominent than that of *harfordiana*. The umbilicus is similar in morphology to that of *clappi*; but typically narrower. Most animals have the mantle almost uniformly black. The lip is rather narrow, not revolute, and broader than that of *clappi*; the columellar insertion is definitely above the umbilicus, which has a small proportion covered by it, similar to *harfordiana* and *Cryptomastix* n. sp. 5 and less open than that of *clappi*. The shell base is low convex.

**Discussion:** This species is present in older collections from the Lucile and White Bird areas. Comparisons with *clappi* and *harfordiana* have been made above; see also discussion of *Cryptomastix* n. sp. 5 above and **APPENDIX A** (key 1P). The species most closely resembles *clappi*; but the anatomy is very distinct, and it differs consistently in several shell features as well. Cited under this name in Frest & Johannes (1995a, b).

**Ecology:** A strong-moderate xerophile. *Cryptomastix* n. sp. 6 prefers dry, exposed taluses, generally basalt. Cover is often limited to grasses, uncommon *Seligeria* and mosses, scattered *Rhus horribilis* or *Sorbus* clumps and uncommon *Celtus* and *Prunus*. Commonly co-occurring land snails are *Allogona ptychophora ptychophora*, *Allogona ptychophora solida,* and several *Oreohelix* species, most often n. sp. 25 (Stites mountainsnail) or *jugalis*. This taxon occurs at much drier sites than *clappi*; but does not do well in the very dry taluses inhabited by *Cryptomastix* n. sp. 3. Sympatric occurrence with *Cryptomastix harfordiana* has been noted at several sites.

**Original distribution:** A strict local endemic, limited to a portion of the Lower Salmon River, Idaho County, ID, from approximately the mouth of John Day Creek to the mouth of Rock Creek (see map 17 in Appendix C, Frest & Johannes, 1995b). All sites noted to date are in the Lower Salmon River corridor.

**Current distribution:** This *Cryptomastix* is locally common, being found at about 23 sites. Its total distribution is rather restricted, the species being confined to a limited area of the main Salmon River corridor. There are several sites at which it is abundant, all very limited in area. Certain of our sites may no longer represent living populations; and the taxon is rare live at most sites. It is unlikely that many additional sites will be found.

**Idaho distribution and comments:** Found downstream from *C.* n. sp. 6 and *C. harfordiana* in a limited part of the main lower Salmon River corridor; and, like those two, a fairly tolerant taxon likely with a nearly continuous but limited range originally, now heavily broken up into small colonies. Not found in Hells Canyon or adjacent states; an Idaho precinctive.

**Specific Idaho sites:** Perhaps 23 live sites: LSR 14, 30, 33, 78-81, 86, 104, 127, 137, 139-141, 144-148, 151, 158. Extirpated colonies are also known in this area.

**Threats:** Essentially all of the Salmon River corridor is grazed, much heavily. As with other species in this region, highway corridors, in particular US 95 and access roads to the public areas upstream and downstream from the mouth of Rock Creek, are located along much of the suitable habitat. Talus mining and roadside spraying are problems for some colonies; and historic sites in the vicinity of White Bird Bridge have been extirpated in recent years. Gold mining has impacted (and likely extirpated) some sites. Certain localities collected in the late 1980s have been extirpated by road modification in the last three years. The species is evidently declining in numbers and areal extent. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Strict local endemic; specialized and limited habitat and distribution; loss of historic sites; occurrence on public lands, including BLM properties.

**Recommended status**: A newly recognized form with no status as yet. Should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (ID) listing as Threatened is warranted, due to habitat loss and decrease in historic sites, ongoing threats, as also stated in Frest & Johannes (1995a, b).

We regard this species as common in the part of the survey area in which it occurs: but the total range is small and unfortunately concentrated in some portions of the Lower Salmon River corridor that are both readily accessible and susceptible to human modification.

**References:** Deixis collections, 1989-1994; Frest & Johannes (1995a, b).

### *Cryptomastix* (*Cryptomastix*) *sanburni* (Binney, 1886)
### Kingston oregonian

**Type locality:** Kingston, Shoshone County, Idaho; holotype ANSP 11119.

**Description:** See Pilsbry (1940) for most complete description and illustrations. Shell not hirsute; fairly strongly convex above; color medium-dark brown; lip white, revolute, comparatively wide; 5 1/2-6 whorls in adult; lamellae very strongly developed, especially parietal; aperture largely closed; umbilicus partly covered by barely reflected columella.

**Discussion:** This species is not at all hirsute as an adult (compare Lochsa oregonian and Mission Creek oregonian: see key 1R, **APPENDIX A**), the lower lip is strongly revolute, the upper less so. It differs from *Cryptomastix magnidentata*, the most closely comparable species, in that the latter is hirsute; additionally, *sanburni* is relatively taller and has more whorls at comparable diameters. The disc oregonian (*Cryptomastix* (*C.*) n. sp. 3, above) also has close whorls; but is much smaller, flatter, has very different apertural morphology, and is a xerophile. Cited under the same designation in Frest & Johannes (1995a).

**Ecology:** This species occurs in lowland and flood plain-edge *Pinus ponderosa* forest slopes with a considerable admixture of deciduous shrubs and a rich forb understory. Seeps and springs and small stream borders may be preferred habitat. Moist valley, ravine, gorge, or talus sites seemingly are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*; this is a mesophile species. Land snail associates include *Cryptomastix mullani mullani*, *Allogona ptychophora ptychophora*, and *Radiodiscus abietum*. The regolith is variable, with basalt, schist, and metasedimentary rocks noted at various old sites.

**Original distribution:** *Cryptomastix sanburni* has been reported from about 5 sites scattered along the Coeur d'Alene river drainage from Coeur d'Alene to Kingston (Kootenai and Shoshone counties, Idaho), and from Hope, Bonner County, Idaho.

**Current distribution:** Uncertain; attempts by us to recollect all 5 historic sites and others in the same areas in 1994 were unsuccessful. Private collectors have also failed to find this species live in recent years (*e.g.,* S. Welty, pers. comm., 1994).

**Idaho distribution and comments:** Strict Idaho precinctive, with 4 sites in the Coeur d'Alene River corridor and one somewhat problematic site near Hope.

**Specific Idaho sites:** See above; all historic sites except the Hope location were rather vague.

**Threats:** Much of the Coeur d'Alene-Kingston area has been extensively mined, and air pollution from smelting and refining operations has seriously affected plant and animal life over extensive areas. Much of the same region has also been logged, and is currently being grazed. Land snails in general are uncommon to absent in this area. Earlier re-collection attempts by Grimm (1974, unpub.) were also unsuccessful. The undescribed species of *Cryptomastix* reported by Grimm (*op. cit.*) at the mouth of Steamboat Creek is apparently also now extinct, due to removal of talus for road building and location of the main river road along the major river corridor, *i.e.,* the upper Coeur d'Alene. This may be a factor in the loss of sites for this species also.

**Criteria for inclusion:** Local endemic; loss of historic sites; current and ongoing threats. Population trends (number of sites, number of individuals) are evidently downward.

**Recommended status:** Currently, has none; it should be considered a Sensitive species by the Forest Service and BLM. We recommend, as we did previously (Frest & Johannes, 1995a), Federal and State (Idaho) listing as Endangered, for the reasons cited above. Despite possible loss of all historic colonies, failure to locate new ones after limited searches, and habitat degradation as described above, it is likely that one or more colonies survive in northern Idaho, although widespread occurrence is highly improbable.

**References:** Pilsbry (1940); Grimm (1974, unpub.); Frest & Johannes (1995a); Deixis collections, 1990 & 1994.

## *Discus marmorensis* Baker, 1932
## marbled disc

**Type locality:** About 2 mi. up middle fork of John Day Creek, lower Salmon River drainage, Idaho County, Idaho; holotype ANSP 156442a; paratypes UCM 22545. See Wu & Brandauer (1982) for UCM types.

**Description:** See Baker (1932) and Pilsbry (1948) for discussion and illustrations. This is a small (8-9 mm diameter at 6 1/2 whorls), low bee-hive shaped taxon with typical discid flammulated chestnut patches on a light brown background; suture abruptly impressed; periphery sharply keeled to aperture; aperture scarcely oblique; strong retractive ribs on upper surface, extending and weakening slightly below periphery but absent from most of lower surface; umbilicus contained about 3 times in full diameter.

Uminski (1963) after *partial* dissections ascribed this species questionably to the genus *Anguispira*. However, more detailed treatments of Discidae by A. Solem (*e.g.*, 1976, 1982) tend to make this assignment implausible, and in any case do not affect species validity, which is unquestioned. Uminski (*op. cit.*) also states that the shell of this species "resembles closely" that of *Anguispira nimapuna*-a statement that is strangely and patently inaccurate, and contrasts oddly with the later statement in the same paper that "[i]n spite of these similarities the shell of *Anguispira* (*?*) *marmorensis* (H. B. B.) is very characteristic and distinct in form and sculpture from the shells of all other *Endodontidae*" (Uminski, *op. cit.*, p. 82). Turgeon *et al.* (1988; 1998) retain this species in *Discus*.

**Discussion:** There are no closely similar western US snails as yet discovered. The small size, beehive-shaped shell; numerous whorls; and mottled coloration are distinctive.

**Ecology:** Generally found at moderate elevations on limestone terrain in relatively intact, moist, well-shaded (closed to nearly closed canopy) *Pinus ponderosa* forests, with diverse deciduous and forb understory. A mesophile-weakly notophile species. Occasionally occurs in moist schist taluses in such forests. In both cases, snail colonies are generally near stream edges and at the base of steep slopes. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.*, low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. Common land snail associates include *Oreohelix* n. sp. 22 (Slate Creek mountainsnail), *Allogona ptychophora ptychophora*, *Anguispira kochi occidentalis*, *Cryptomastix mullani latilabris*, and *Hemphillia* sp. cf. *camelus*.

**Original distribution:** Found only in central portions of a few major tributaries to the lower Salmon River (east side only), in the vicinity of Lucile, Idaho County, Idaho.

**Current distribution:** Survives in a few colonies in central portions of two creek tributaries to the lower Salmon River. Sites are on BLM, Nez Perce National Forest, and private lands. The type locality is still extant (re-collected in 1993). The species is declining, due to habitat loss (as described below). Much or all of the area of known and potential occurrence was surveyed by us in recent years (Frest & Johannes, 1995b: details of site location and map); many other workers, including H. Hemphill, H. B. Baker, W. Walton, and A. Solem have collected this region. Thus, it is unlikely that many additional sites will be found.

**Idaho distribution and comments:** Another lower Salmon River endemic; limited to tributary drainages from one side of a single accreted terrain limestone block

**Specific Idaho sites:** Perhaps seven: LSR 43, 46, 47, 175-178.

**Threats:** Much of the original area of occurrence has been logged and is now heavily grazed; the species is absent from such areas. Limestone quarrying has eliminated much or all of one colony in the last 3 years. Roads in the area of occurrence are generally situated such as to fragment or eliminate colonies. All known sites appear to have been reduced in area due to one or more of the factors cited. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Local endemic; past and ongoing threats, as detailed above; intact forest and riparian corridor species, with most sites on public lands.

**Recommended status:** Until recently a C2 candidate (USFWS, 1994); should be considered a Sensitive species by the Forest Service and BLM. There is sufficient recently-collected information, and recent survey work (*e.g.*, Frest & Johannes, 1995a), to recommend Federal and State (Idaho) listing as Endangered, due to habitat loss, ongoing threats, declining numbers. We made the same recommendation previously (Frest & Johannes, 1995a, b).

**References:** Baker (1932); Pilsbry (1948); Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

### *Ogaridiscus subrupicola* (Dall, 1877)
### southern tightcoil

**Type locality:** "Clinton's Cave, east of Lake Point Station, Tooele Co.", Utah (Dall, 1877). The holotype may be lost; paratypes USNM 67356.

**Description:** The best summary description and illustration are in Pilsbry (1946); see also Baker (1930, 1931). As regards shell features, the small size (to 3.5 mm at 5 1/2 whorls); close coiling, with the last whorl not appreciably more rapidly expanding; barely perforate umbilicus; and near-discoidal conch readily distinguish this species from anything else in its range. The shell is very thin; transparent; and nearly colorless; the surface sometimes has very faint transverse grooves (even weaker than typical for *Pristiloma*) and patchy, nearly obsolete spiral striae.

**Discussion:** Generic status dates to Chamberlin & Jones (1929); Baker (1930, 1931) and Pilsbry (1946) treated it is a subgenus. However, the most recent comprehensive revision of the Zonitidae (Riedel, 1980, p. 34) cogently argues for generic status: "...die Genitalien sind aber so abweichend gebaut und charakteristich, dass man *Ogaridiscus* als selbständige Gattung betrachten soll". This genus is monotypic at present, although other anatomically unknown or as yet undescribed "*Pristiloma*" could belong here. For comparisons with area *Pristiloma* species, see key 1S (**APPENDIX A**).

**Ecology:** A weakly xerophile-mesophile species occurring among rocks and brush; poorly known. The Oregon site is a short, rather dry, north-facing basalt cliff face and shallow talus in open Ponderosa pine and Douglas fir forest, elev. 2000'. Associates here were such rare taxa as *Megomphix lutarius*, *Pristiloma idahoense*, and *Polygyrella polygyrella*, as well as *Radiodiscus abietum*, *Microphysula ingersolli*, and some more widespread forms (Baker, 1932). The Idaho site is in a drainage to a tributary to the Coeur d'Alene River, in open Ponderosa pine forest.

**Original distribution:** Reported reliably from three widely separated sites: Clinton's Cave, Tooele County, Utah; east fork of Willow Creek, Shoshone County, Idaho; and Pine Creek Valley, above Weston, Umatilla County, Oregon. We have not found this taxon at our Idaho sites; nor has R. B. Brunson (pers. comm., 1993) at his western Montana sites or T. Burke (pers. comm., 1996) at his eastern Washington localities.

**Current distribution:** Uncertain; none of the old sites has been recollected successfully in recent years, to our knowledge. We did not find this species in a brief search in 1994. R. B. Brunson did not find this species in western Montana; neither T. Burke nor S. Welty have found this species at their Idaho or eastern Washington sites. We have one recent collection from near Troy, Wallowa County, Oregon.

**Idaho distribution and comments:** Note the very scattered distribution record of this taxon. Even though it is quite likely that it is more common than now appears, detailed searches of such areas as the lower Salmon River

drainage suggest that it is currently quite rare. So far as we are aware, our recent collections are the only ones. This species is most likely to occur in Idaho south of the Panhandle, in the more arid to semi-arid parts of the state.

**Specific Idaho sites:** Dead at one LSR site (185). Not otherwise seen recently in Idaho.

**Threats:** The area above Weston is heavily grazed, and most has been logged. The Idaho site is in an area that has mostly been logged; is grazed currently; and is part of the Coeur d'Alene-Kingston mining district. Some of this area has been severely affected by smelter emissions and mining wastes. Probably, population trends (in number of sites and number of individuals) are downward.

**Criteria for inclusion:** A regional endemic, reported from a few, widely scattered sites; lack of recent collections; threats in areas of known past occurrence; monotypic genus.

**Recommended status:** This species has no special status at present. It should at least be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal listing as Threatened may be appropriate for the reasons cited above: we made the same recommendation in Frest & Johannes (1995a). Similar status (Threatened) is suggested for the States of Oregon, Idaho, and Utah.

**References:** Baker (1930, 1931); Pilsbry (1946); Deixis collections, 1992, 1994; Frest & Johannes (1995a).

### *Oreohelix hammeri* Fairbanks, 1984
### Mount Sampson mountainsnail

**Type locality:** Mount Sampson, Seven Devils Mountains, elev. 5500', NE1/4 sec. 22, T 23 N R 1 W, Rapid River drainage, Idaho County, Idaho, Nez Perce National Forest. Holotype USNM 809997, paratypes USNM 809998; other paratypes H. L. Fairbanks 432, Deixis collections.

**Description:** See Fairbanks (1984) for discussion and illustrations. Affinities of this species are with the *intersum* species group; but it is not closely similar to that or any of the new species in this group mentioned below. One of the most distinctive *Oreohelix* species, with shell features most closely similar to *Oreohelix elrodi* but quite different soft anatomy. See discussion in Frest & Johannes (1995b); for comparisons with the many other *Oreohelix* species in its range, see key 1Q, **APPENDIX** A. This is a large *Oreohelix* species (22 mm at 5 1/4- 5 1/2 whorls) with a strongly depressed, lenticular shell; very low conoid spire; embryonic whorls as in *O. intersum*; later whorls with moderately numerous slightly uneven retractive ribs (much higher and narrower as well as more numerous than those of O. elrodi). Typical *Oreohelix* color bands generally absent; color faintly pinkish or purplish brown; umbilicus well-like, over 1/3 full shell diameter, but base abruptly deflected into umbilicus so as to give almost keeled appearance; aperture slightly expanded, reinforced all around slightly, deflected slightly to strongly in last 1/4 whorl.

**Discussion:** Affinities of this species anatomically are with the *intersum* species group; but it is not closely similar in teleoconch features to that or any of the new species in this group mentioned below. One of the most distinctive *Oreohelix* species, with adult shell features most closely similar to *Oreohelix elrodi* but quite different soft anatomy. See discussion in Frest & Johannes (1995b); for comparisons with the many other *Oreohelix* species in its range, see key 1Q, **APPENDIX** A.

**Ecology:** Dry, open south- and southwestern-facing limestone outcrops and talus; scattered grasses, *Physocarpus*, *Mertensia*, glacier lily, *Amelanchier*. Other, possibly new species of *Oreohelix* occur in the immediate vicinity. A moderately xerophile taxon; and possibly a calciphile and hypsiphile.

**Original distribution:** Known only from the type locality.

**Current distribution:** May survive at the type locality, which was included in a severe forest fire in 1994. Searches of the Rapid River area by us and by private collectors from 1989-1994 have not resulted in the finding of other sites. A survey of over 200 sites in the lower Salmon River valley (Frest & Johannes, 1995b) produced no additional sites for this species, which was also not found by earlier collectors. Systematic collection of the lower Salmon and tributary valleys began in the 1860s and has continued to the present. It is unlikely that many additional sites will be found.

**Idaho distribution and comments:** See above. Judging from nearby sites, it is quite likely that this taxon will be found in only a very limited area, like several of its nearby neighbors.

**Specific Idaho sites:** Just one, the type locality (see above).

**Threats:** Forest fires; continued logging and grazing in area. This area (Rapid River-Seven Devils) was the scene of extensive prospecting and mining in the past, some of which continues.

**Criteria for inclusion:** Local endemic; past and continuing threats; occurrence on public lands. Population trends (number of sites, number of individuals) are likely downward.

**Recommended status:** Has no special status at present; it should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies. We recommend Federal and State (Idaho) listing as Endangered (as we did in Frest & Johannes, 1995a, also), due to very limited range and past and present threats.

**References:** Fairbanks (1984); Frest & Johannes (1995a, b).

### *Oreohelix haydeni hesperia* Pilsbry, 1939
### western mountainsnail

**Type locality:** North-facing limestone talus 2 1/2 mi. up John Day Creek, lower Salmon River valley, Idaho County, Idaho; holotype ANSP 174022a (for more detailed location of this site, see Frest & Johannes, 1995b).

**Description:** See Pilsbry (1939) and Frest & Johannes (1995b) for description and illustrations. *Hesperia* is a large taxon (25-30 mm diameter at 4 1/2-5 whorls) with a biconvex, generally strongly depressed shell; spire low to very low conoid; strong, slightly pinched peripheral keel; strong spiral ribs on both surfaces (generally 4-6); strong transverse growth lines between ribs; umbilicus near circular, about 1/4 full shell diameter. Aperture angular, slightly oblique; not strongly reinforced generally not expanded or deflected. Color in most populations light pinkish or purplish brown, with color bands obsolete; some populations distinctly darker purple-brown, with both color bands distinct, brown; lower especially prominent. Sculpture varies in prominence between individuals but always strong.

**Discussion:** The only other named *Oreohelix* species with even closely similar shell features is the rare Colorado form *Oreohelix haydeni betheli*. In Idaho, possibly more than one species is involved (each would be quite rare if this surmise is correct); see Frest & Johannes (1995b) for discussion. We prefer to keep all known sites under this rubric pending further study. Comparisons with the many other *Oreohelix* species in its range are made in key 1Q, **APPENDIX** A.

**Ecology:** Generally found on limestone outcrops and limestone talus in rather open *Pinus ponderosa* forest, at moderate elevations. The type locality is a comparatively open and dry large-scale talus with grasses, *Sorbus*, *Amelanchier*, and *Rhus*. Common large land snail associates are *Cryptomastix mullani latilabris* and *Allogona ptychophora ptychophora*. At forested sites, associates include other *Cryptomastix* spp., *Anguispira kochi occidentalis*, and *Allogona ptychophora ptychophora*. At one site, *Discus marmorensis* was also found with this

taxon. The forest sites are comparatively dry and open; in moist and riparian sites, this species is very rare or absent; a xerophile. This taxon occurs at a range of elevations.

**Original distribution:** Probably at one time widespread over several tributaries of the lower Salmon River (east side only), in the vicinity of John Day Creek. Long-dead shells are still common at many sites in which live individuals were no longer present, 1988-1994.

**Current distribution:** Restricted to a few remnant colonies in the area of its original distribution, on private, BLM, and Nez Perce National Forest lands. Known and potential range were surveyed recently (Frest & Johannes, 1995b). Many other malacologists have collected in this area, both private and professional, beginning in the 1860s. For details on sites and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** An Idaho (lower Salmon River corridor, just along parts of a single major tributary valley (John Day Creek) and possibly along a second, minor tributary) precinctive.

**Specific Idaho sites:** Currently, about 9 live sites, in two closely adjoining areas: LSR 33, 43, 47, 48, 60-62, 184, 185.

**Threats:** Logging, grazing, forest fires, and agricultural use of most of the original range. Areas heavily grazed and/or clear-cut lack this species. Within the original range, literally millions of dead shells may be found in areas so treated, which now either lack the species entirely or have it restricted to fortuitous small rock outcrops. The species has probably lost more than 90% of its original range. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Local endemic; habitat loss, as detailed above and in Frest & Johannes (1995b); occurrence on public lands.

**Recommended status:** Currently this taxon has no special status; it should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies. Federal and State (Idaho) listing as Endangered (as also argued in Frest & Johannes ,1995a), due to habitat loss, population declines, and other factors outlined above, should also be considered.

**References:** Pilsbry (1939); Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

### *Oreohelix haydeni perplexa* Pilsbry, 1939
### enigmatic mountainsnail

**Type locality:** Twilegar Gulch, sec. 35, T 26 N R 1 E, Idaho County, Idaho, lower Salmon River drainage; holotype ANSP 174024a.

**Description:** See Pilsbry (1939) for description and illustrations; see also Frest & Johannes (1995b). This is a medium-sized taxon, generally about 15 mm diameter at 5 1/2 whorls; shell low conic, appears terraced in side view; whorls convex but with strong ornament of spiral ribs and transverse lirae, plus finer spiral sculpture; peripheral rib commonly somewhat stronger; early whorls very low, brown, sculpture typical for *haydeni* group. Aperture almost circular except for slight peripheral angle; generally not reinforced; very slightly deflected; umbilicus narrow, deep, about 1/5 full diameter. Color bands generally faint or absent; shell color generally even light pinkish brown.

**Discussion:** The unique (for *Oreohelix*) shell ornament with crossed, equally-strong spiral ribs and lirae (cancellate pattern: "lattice" of Pilsbry, 1939, p. 476 sculpture) make it one of the most unusual US land snails, and hence easily subject to overcollecting. Reference key 1Q (**APPENDIX A**) for further comparisons.

**Ecology:** Open, rather dry sage scrub with small-scale limestone talus (mostly west-facing) and outcrops; grasses, *Artemisia* spp., *Amelanchier*, rare *Opuntia*, and *Physocarpus*. Associated land snails include *Cryptomastix harfordiana*, *Helicodiscus salmonaceus*, and *Allogona ptychophora ptychophora*. The known site is at moderate elevations and is bordered on all sides by other *Oreohelix* spp. colonies. This taxon appears to be a moderate-strong xerophile, and could be a calciphile also.

**Original distribution:** A single extended colony in Twilegar Gulch. This colony is bordered on three sides by colonies of other *Oreohelix* species, notably *Oreohelix idahoensis idahoensis* and *Oreohelix* n. sp. 20 (Frest & Johannes (1995b). For details on site and map, see Frest & Johannes (1995b).

**Current distribution:** Small remnant colonies in protected areas within the limits of the original sites. Common dead shells indicate that at least 70% of the original site no longer has living individuals (Frest & Johannes, 1995b). Reduction in numbers has been observed during several visits, 1989-1994.

**Idaho distribution and comments:** A very characteristic strict lower Salmon River corridor precinctive, found along the east side of the river on one major metasedimentary "marble" (limestone) outcropping.

**Specific Idaho sites:** LSR 195.

**Threats:** Heavy grazing; fires, which have occurred in the immediate area in recent years; overcollecting.

**Criteria for inclusion:** Extremely local endemic; ongoing and past threats; observed decline in area occupied and live population size.

**Recommended status:** Surprisingly, this taxon has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies. Federal and State (Idaho) listing as Endangered, due to extremely limited geographic range and declining numbers and condition of habitat, should be undertaken. The same re-commendations were made previously (Frest & Johannes, 1995a).

**References:** Pilsbry (1939); Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

### *Oreohelix idahoensis baileyi* (Bartsch, 1916)
### Seven Devils mountainsnail

**Type locality:** Seven Devils Mountains, Idaho, "on a limestone ridge on the side of a rapid creek" (Bartsch, 1916), elev. 3700'; holotype USNM 133221; paratypes USNM 133221a. This rather vague locality could refer either to the Hells Canyon or Rapid River sides of the Seven Devils.

**Description:** See Bartsch (1916) for description and illustrations of shell (holotype). We examined the two paratypes also in 1991; they are essentially identical in morphology to the holotype. See discussion in Frest & Johannes (1995a, b). Specimens referred to this form by Winslow (1920) and Pilsbry (1939) [in part] are placed herein in either *Oreohelix* n. sp. 18 (Limestone Point mountainsnail) or *Oreohelix* n. sp. 20 (Sheep Gulch mountainsnail) [*q.v.*]. This species is more depressed; has more convex whorls; and has a much larger umbilicus than either of the new forms. It is also smaller than *Oreohelix* n. sp. 18. The weak peripheral rib is also distinctive: *Oreohelix* n. sp. 18 has a very strong peripheral rib; while *Oreohelix* n. sp. 20 has an angulate periphery. See key 1Q, **APPENDIX A,** for further comparisons.

**Discussion:** Anatomy of this taxon is unknown, and we were unable to determine juvenile shell characters sufficient to assign this taxon to a species group, though it obviously is distinct at the subspecies level or higher. Affinities are uncertain, as some forms we would place in the *Oreohelix intersum* species group (see discussion below) may be similar in shell morphology. Most likely relationships are to the *Oreohelix idahoensis* species group.

**Ecology:** Occurs on limestone outcrops and in limestone talus, often rather dry and open, at moderate elevations. Details and associates are unknown. Probably a strong xerophile and calciphile.

**Original distribution:** Known from the type locality only; not relocated or recollected in recent years. Specimens ascribed to this species from the lower Salmon River canyon (except possibly for areas very near the mouth) belong to another species, *Oreohelix* n. sp. 20 [see below and Frest & Johannes (1995a, b)]. Other Hells Canyon specimens with somewhat similar morphology are assigned to *Oreohelix* n. sp. 18. The other vaguely similar Hells Canyon species, the Pittsburg Landing mountainsnail, is distinctive in a number of ways (see *Oreohelix* n. sp. 30). We have not found this taxon as yet at any of our Hells Canyon or lower Salmon River sites.

**Current distribution:** Uncertain. Likely to occupy a small stretch of the Seven Devils terrain, Idaho, sandwiched between better-known taxa. The elevation suggest it likely occurs on Nez Perce or Payette National Forest lands in the Seven Devils Mountains, though it could occur on BLM (Hells Canyon National Recreation Area) or on private inholdings.

**Idaho distribution and comments:** Probably Seven Devils area, Idaho.

**Specific Idaho sites:** Single site only vaguely described (see above). Not rediscovered so far.

**Threats:** Grazing; logging; forest and range fires; mining or other development on private lands in southern and central Hells Canyon. As these factors are extensive throughout the likely area of occurrence, population trends (number of sites, number of individuals) are highly likely to be downward.

**Criteria for inclusion:** Local endemic; restricted habitat; past and ongoing threats; likely decline in sites and population; possible occurrence on public lands, including Hells Canyon National Area, Wallowa-Whitman and Nez Perce National Forests.

**Recommended status:** Currently, has none; it should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies. In our opinion, Federal and State (Idaho) listing as Endangered would be appropriate (as also stated in Frest & Johannes, 1995a, b); rationale discussed above. It is unlikely that many additional sites will be found.

**References:** Bartsch (1916); Winslow (1920); Pilsbry (1939); Frest & Johannes (1995a, b); Deixis collections, 1989-1990.

### *Oreohelix idahoensis idahoensis* (Newcomb, 1866)
### costate mountainsnail

**Type locality:** Specimens received from the original collector (Henry Hemphill) bear labels reading "between Idaho City and the Coeur d'Alene mining district [about 200 mi.]", "Lucile", and "Salmon River Mountains". As Hemphill collected extensively in the area about Lucile, lower Salmon River, Idaho County, Idaho, it is generally accepted that this region is the source of Hemphill's specimens (Pilsbry, 1939). Holotype ANSP 10857a. Probable paratypes (certainly topotypes) from Hemphill's collection are widely scattered in major US and foreign museum and private collections, including our own.

**Description:** See Pilsbry (1939) for description and illustrations and Solem (1975) for modern dissection; see also Frest & Johannes (1995a, b). This form may not actually be closely related to true *idahoensis baileyi*, although both could be in the same species group (see above). The higher spire, larger number of whorls, high, widely spaced white ribs and brown (bandless) ground color, small umbilicus, and deflected aperture are distinctive features. Rib spacing in *Oreohelix* n. sp. 18 [Limestone Point mountainsnail] is closer; transverse ribs are not as prominent; the spire is not as high; there is a distinct peripheral rib; there is little contrast in color between

transverse ribs and interspaces; and the umbilicus is proportionately smaller. *Oreohelix* n. sp. 20 [Sheep Gulch mountainsnail] has a small, much more depressed spire, wide umbilicus, weak to absent peripheral keel, and fine, more closely spaced transverse ribs. See key 1Q, **APPENDIX A.**

**Discussion:** The only other taxon with any close resemblance is the final known member of the *idahoensis* species group, the Pittsburg Landing mountainsnail, *Oreohelix* n. sp. 30. This species has a somewhat similar shell shape; however, the umbilicus is larger; spiral striation is not well developed; the radial ribs, though prominent, are narrower and more narrowly spaced, more as in *Oreohelix peripherica newcombi* than in the other *idahoensis*-group taxa; and the two typical color bands of *Oreohelix* (absent in *idahoensis*) are well developed. The Hells Canyon taxon also lacks any kind of peripheral keel, rib, or angulation.

**Ecology:** Restricted to low-middle elevation limestone and calcareous schist outcrops and talus, generally in sage scrub; typically in rather dry and open terrain with common *Artemisia* and grasses; less common *Amelanchier*, *Celtus*, *Opuntia*. Usually occurs in monospecific colonies, occasionally with *Cryptomastix harfordiana* and *Succinea* sp. See Frest & Johannes (1995a, b) for further information. A strongly xerophilic species and a calciphile.

**Original distribution:** A small area a few miles long on both sides of the lower Salmon River, Idaho County, Idaho, in the vicinity of Lucile.

**Current distribution:** Restricted to a few colonies within the original area of distribution. The area of known and likely occurrence has been visited many times by malacologists; the most recent survey is by Frest & Johannes (1995b, c). For details or maps, see Frest & Johannes (1995a, b, c). A detailed map of the Lucile Caves population is available in Frest & Johannes (1995c).

**Idaho distribution and comments:** A lower Salmon River corridor strict endemic. Note that the detailed work done by us on Lucile ACEC tends to inflate the number of sites. This taxon appears to have originally occupied perhaps three (possibly four) exotic terrain blocks. In other words, all of the Lucile ACEC sites probably historically were a single population. this may apply to the other terrain blocks as well. We believe that the river border site mentioned by Solem (1975) was ephemeral, as such sites often are. Only sites above the high water mark are likely to persist for long periods of time.

This very beautiful taxon is also an Idaho endemic; and, as mentioned above, it is quite likely that the other named subspecies, currently a lost taxon, is in reality not very closely related.

**Specific Idaho sites:** LSR 12, 14, 15, 17, 21, 32, 37, 38, 41, 42, 67, 69, 100, 104-106, 109, 117, 127, 135-140, 144, 146, 163, 186, 190, 209, 213 (roughly 32 live sites).

**Threats:** Grazing; gold mining; talus and limestone quarrying; range fires. One large colony is now near extinction due to a combination of grazing and recent fires. Dead shells mark an area more than 20 times the present live occurrence. Building in Lucile has also impacted sites. In one area, sheep grazing has eliminated most of one colony, while remnants on the opposite side of the road (protected from grazing) have abundant snails. Similar effects from grazing and other causes can be observed at all remaining sites. Apparently extinct colonies occur north of Riggins. The species is declining. This species, termed by Pilsbry "one of our prettiest land shells", is also a favorite of collectors. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Local endemic with specialized habitat; declining populations and area of occurrence; current and past threats; occurrence on federal (BLM) lands.

**Recommended status:** We favor Federal State (Idaho) and listing as Threatened, if BLM Lucile ACEC sites can be thoroughly protected; otherwise Endangered. Note that the same recommendations were made in Frest & Johannes (1995a, b, c). This species was until recently a federal Category 2 candidate (USFWS, 1994). It should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were

conducted by Frest & Johannes (1995b, c). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is unlikely that many additional sites will be found.

**References:** Pilsbry (1939); Solem (1975); Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

### *Oreohelix intersum* (Hemphill, 1890)
### deep slide mountainsnail

**Type locality:** Stone piles at the foot of a steep bluff back some distance from the banks of the Little Salmon River, Idaho County, Idaho; lectotype SBMNH 33930; paralectotypes CAS 58867; 54557; 54558; 54561; USNM 363248; AMNH 61704; 61705. See Coan & Roth (1987) for discussion of accurate lectotype designation for this species, *vs.* Hanna & Smith (1939).

**Description:** Pilsbry (1939, in part) has the best illustrations. This is a medium-sized *Oreohelix* species (*ca.* 16-18 mm diameter at 5 1/2 whorls); shell low conoid-conoid; whorls generally convex, well-rounded, but with barely subangular periphery; sutures deep; ribs narrow, strong, numerous, slightly irregular, thin, about equal above and below; umbilicus narrow, about 1/4 full diameter; aperture oblique, slightly angular peripherally; thickened, slightly to strongly deflected in last 1/8 whorl. Color bands well developed, moderate in width, medium brown; groundcolor generally pale reddish-brown.

**Discussion:** Pilsbry (1939) regarded this species as a subspecies of *jugalis*. However, it was more plausibly regarded as a full species by Berry (1932) and Hanna & Smith (1939). Species status was convincingly demonstrated by Solem (1975); see discussion in Solem (1975) and Frest & Johannes (1995b). Dissection indicates that this species is not particularly closely related to *Oreohelix jugalis*, as Pilsbry originally thought. Species with closely comparable anatomy have so far been noted by us only in the Little Salmon River-lower Salmon River area of Idaho and constitute a distinct species group. For regional comparisons, consult key 1Q (**APPENDIX A**).

**Ecology:** Found primarily in rather dry and open basalt and (rarely) schist talus slides, all at lower elevations; grasses, scattered clumps of *Rhus horribilis* and *Sorbus*; *Celtus*, and *Amelanchier* and *Opuntia* are the usual plant associates. Colonies are generally surrounded by sage scrub (*Artemisia*, *Balsamorrhiza*). Despite the common name, rock taluses with this species need not be large or deep. This taxon often is the only large land snail present at a site. See Frest & Johannes (1995a, b) for further details. A moderately-strongly xerophilic taxon.

**Original distribution:** Lower few miles of Little Salmon River drainage, including larger tributaries, Idaho County, Idaho.

**Current distribution:** Scattered sites within area of original distribution. See Frest & Johannes (1995b) for details on sites and site map.

**Idaho distribution and comments:** A Little Salmon River corridor taxon, occupying only a few square miles of range.

**Specific Idaho sites:** Currently, 4 live sites, rather isolated from each other despite the small total range: LSR 16, 110-112.

**Threats:** Grazing; road construction, *e.g.*, US 95 corridor; talus mining; irrigation system construction; roadside spraying for weed control. Each of the above has been observed to impact at least one colony in recent years. In heavily grazed areas, colonies are absent or limited to small areas protected by fortuitous circumstances. The species is declining, both in terms of absolute numbers and area occupied. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Occurrence on public lands (BLM); local endemic with rather specialized habitat; observed threats, declining numbers; habitat loss.

**Recommended status:** At present, this species has no special status. It should be considered a Sensitive species by the Forest Service, BLM, and other land management agencies Federal and State of Idaho listing as Endangered is recommended for the reasons stated above; note that the same recommendation was made in Frest & Johannes, 1995a. Comprehensive recent surveys of the lower Salmon, part of the Little Salmon, and Rapid River drainages for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is unlikely that many additional sites will be found.

**References:** Pilsbry (1939); Hanna & Smith (1939); Solem (1975); Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

### *Oreohelix* n. sp. 8
### Squaw Creek mountainsnail

**Type locality:** None at present; undescribed taxon.

**Description:** Medium-sized (to 14 mm) species with up to 5 whorls. Shell biconvex; upper surface almost flat; color greenish-yellow. Strong peripheral keel with periostracal fringe; other less pronounced periostracal wreaths on low lirae developed on lower surface only; upper with about 7-9 fine, closely spaced lirae; lower with 4-6 rather widely spaced fringed lirae. Growth lines strong on both surfaces; sutures barely impressed. Color bands absent. Umbilicus deep, wide, about 40% of shell diameter. See key 1Q, **APPENDIX A** for regional comparisons.

**Discussion:** This species is a member of the *haydeni* complex. It does not closely resemble any other Salmon River taxon. Among known forms, it is closest in shell characters to two species. The Lava Springs mountainsnail (*q.v.*) of southeastern Idaho is similar in color but that taxon has a larger shell, with flatter dorsal surface; fewer lirae, especially on the upper surface; and much less prominent periostracal fringes. *Oreohelix barbata* Pilsbry, 1905 has similar cuticular wreaths, but the bearded mountainsnail is brown, less broadly umbilicate, less depressed, and has a strongly oblique aperture. Internal anatomy of the Arizona-New Mexico *Oreohelix barbata* is similar in many respects to that of *Radiocentrum* species (Pilsbry, 1939), while that of this taxon is similar to members of the *Oreohelix haydeni* species group (which does not occur in Arizona or New Mexico).

This species was discussed in Frest & Johannes (1995a) under the same rubric.

**Ecology:** Found in dry, open, small to large-scale basalt talus, generally west-facing, generally near the talus base only, at moderate elevations; a moderate-strong xerophile. Associated plants include common *Sorbus* and grasses, less common *Balsamorhiza*, *Celtus*, and *Artemisia*. A small bryophyte component is sometimes present also. Most often, this is the only large land snail found. At one site rare dead *Cryptomastix mullani* (subsp. uncertain) were also noted. East-facing and lower, more moist taluses in the same drainage lacked this species. A moderately xerophile species.

**Original distribution:** Probably confined to a portion of the Little Salmon River drainage, Idaho County, Idaho.

**Current distribution:** Confined to a few small colonies along Squaw Creek. Most basalt taluses in the area lack the species or have only long-dead shells; the species is rare at known sites, and evidently declining. For more information and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** A very narrow endemic, in essence confined to parts of a single extensive basalt talus along one side of a single creek (and known to be absent from most of that talus, as well as similar taluses in the same creek drainage and those nearby).

**Specific Idaho sites:** Only one definite live site; dead shells at two others (LSR 57, 58, 156).

**Threats:** Talus mining; road construction and maintenance (FS 517); grazing is heavy in the area despite the prevalence of moderately steep and poorly vegetated talus. Heavily disturbed and shallow taluses lacked live specimens, although long-dead shells indicated former occurrence in some areas.

**Criteria for inclusion:** Very local endemic; habitat loss and continuing threats; occurrence on public lands (BLM and Nez Perce National Forest; see Frest & Johannes, 1995b for details). Comprehensive recent surveys of the lower Salmon and part of the Little Salmon and Rapid River drainages for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. Population trends (number of sites, number of individuals) are downward. It is very unlikely that many additional sites will be found.

**Recommended status:** This species has no special status at present; it definitely should be considered Sensitive by state and federal (*e.g.*, BLM) land and wildlife managers. We suggest, as we did previously (Frest & Johannes, 1995a), Federal and State (Idaho) listing as Endangered, due to current rarity, habitat loss, and continuing threats.

**References:** Frest & Johannes (1995a); Deixis collections, 1993-1994.

### *Oreohelix* n. sp. 9
### Bluebird Canyon mountainsnail

**Type locality:** Yet to be designated; undescribed taxon.

**Description:** Shell small for genus; thin to moderately thick, to 11 mm diameter; adults with 5 1/2 whorls; whorls convex, sutures deeply impressed; spire low and broadly conical. Color bands very faint; transverse ribs white, interspaces light purplish brown. Whorls with strong, somewhat irregularly spaced transverse lirae, equal on both shell surfaces. Umbilicus deep, well-like, about 1/8 maximum shell diameter. Final 1/4 whorl often weakly-strongly deflected; not reinforced.

**Discussion:** A small species of *Oreohelix* related anatomically and in shell features to the Utah Wasatch Range *Oreohelix peripherica* group. The Idaho taxon is distinguished from the Utah members of the group by it smaller size, bandless shell with a unique mottled color pattern, and details of the microsculpture and anatomy.
Cited in the same manner in Frest & Johannes (1995a).

**Ecology:** The live occurrence is in an east-facing shallow limestone talus (live at talus base only). The site is open and grassy, and rather dry; this species is a moderate xerophile. Surrounding vegetation includes *Celtus*, *Physocarpus*, and *Prunus*; nearby areas with *Celtus*, *Artemisia*, and *Balsamorrhiza* are much more typical.

**Original distribution:** Known live only from a portion of a single talus in Bluebird Canyon, Lost River Range, Challis National Forest, Custer County, Idaho. Nearby sites in the Pass Creek drainage and elsewhere in the Lost River Range do not have this species.

**Current distribution:** See above. Occurrence at other sites in Challis National Forest, *e.g.,* in Butte County, is possible, although it is unlikely that many additional sites will be found.

**Idaho distribution and comments:** The range of the occurrence is not well known; but searches in the vicinity failed to turn up additional colonies, a pattern not unfamiliar in southeastern Idaho and northeastern Utah (Wasatch and associated ranges), where several other taxa also have such limited distributions.

**Specific Idaho sites:** A single site, 985. Likely to remain a strict Idaho endemic, confined to southeastern Idaho.

**Threats:** Grazing; road-building; portions of this talus have been leveled and removed, presumably for a pullout and picnic area. The snail now occurs live only in a portion of the remaining talus and is absent from nearby similar-appearing habitat. Other Idaho Great Basin limestone ranges have been extensively mined for phosphate. Population trends (number of sites, number of individuals) are believed to be downward.

**Criteria for inclusion:** Local endemic; limited range; grazing and road building at only known site; occurrence on public lands.

**Recommended status:** None as yet, either federally or in Idaho; requires more detailed surveying. However, the species at least should be regarded as Sensitive by federal (Forest Service) land and wildlife managers. There is a good possibility that this taxon is a narrow endemic which will be found to require protection. The same recommendations were made in Frest & Johannes (1995a).

**References:** Frest & Johannes (1995a); Deixis collections, 1991 & 1993.

## *Oreohelix* n. sp. 12
## hackberry mountainsnail

**Type locality:** To be designated when species is formally described and named.

**Description:** Shell large for genus, to 22 mm at 5 1/2 whorls (maximum adult size). Spire low conical, with somewhat convex whorls, weak peripheral keel, and slightly impressed sutures. Keel continues to aperture; aperture thin, not deflected; strongly oblique, rounded except on parietal wall; parietal callus thin. Umbilicus moderately deep, elliptical, 1/4-1/5 maximum shell diameter. Shell with large, low, slightly irregular transverse ribs, more or less evenly spaced. Ribs slightly stronger above shell periphery. Spiral striation absent. Color bands generally 2; thin; about equal above and below periphery; upper surface sometimes light brown; both surfaces occasionally with additional very thin color bands.

**Discussion:** A large member of the *Oreohelix intersum* group, characterized by a large, rather high spire; large umbilicus; ribbing more distinct on upper surface. See key 1Q (**APPENDIX A**) for regional comparisons. Discussed under the same name in Frest & Johannes (1995a, b).

**Ecology:** This strong xerophile lives on relatively open mixed alluvial and limestone talus slopes. All are dry and poorly vegetated (largely open), with grasses and *Celtus* the most common species. Colonies are almost monospecific, with occasional individuals of *Allogona ptychophora ptychophora* the only other large land snail.

**Original distribution:** Probably confined to a portion of the lower Rapid River valley, Little Salmon River drainage, Idaho County, Idaho, east side of the Seven Devils Mountains, and absent from high elevations and moist lowland situations.

**Current distribution:** Known live from about three colonies in the lower Rapid River drainage. One or more appear to be on Nez Perce National Forest lands. For details on sites and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** Confined to a few square miles of the Rapid River valley; another lower Salmon River strict endemic. Existing colonies are quite small, even considering the small total range, and found in areas fortuitously protected (temporarily) from grazing.

**Specific Idaho sites:** LSR 113-116.

**Threats:** The whole known range is heavily grazed, and colonies appear to be confined to fortuitously protected areas. Dead shells indicate former much more widespread occurrence. Colonies are on or near horse/foot trails into Rapid River back country; the slope with surviving sites has been sapped, possibly to provide material for an adjacent Idaho Power fish hatchery.

**Criteria for inclusion:** Very local endemic; impacts on all known sites. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** To date, this species has no special status. We believe (as stated previously in Frest & Johannes, 1995a, b) that it should minimally be regarded as Sensitive by state, federal (*e.g.*, Forest Service), and other land and wildlife managers as appropriate. We suggest Federal and State (Idaho) listing as Endangered, due to the limited area of occurrence, ongoing threats, reduced number and size of sites, and other threats discussed previously. Comprehensive recent surveys of the lower Salmon and part of the Little Salmon and Rapid River drainages for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is unlikely that many additional sites will be found.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Oreohelix* n. sp. 13
### Rapid River mountainsnail

**Type locality:** To be designated when the species is described.

**Description:** Shell in mid range for genus; diameter at 5-5 1/2 whorls (maximum adult size) about 16 mm. Spire low, sutures moderately impressed; surface with coarse, broad, rather widely-spaced, and somewhat irregular ribs, equal on both shell surfaces. Color bands generally thin, equal; secondary thin bands sometimes present on both surfaces; upper whorls light brown except for ribs. Umbilicus rather deep, abrupt, somewhat well-like, about 1/4 to 1/3 full shell diameter. Periphery distinctly angulate; angulation continues to aperture; aperture very strongly oblique.

**Discussion:** A medium-sized member of the *Oreohelix intersum* group, characterized by a rather low spire; large umbilicus; distinct coarse ribbing on both surfaces. The nearest relative is *Oreohelix* n. sp. 12; aside from just-noted differences, the proportionately wider and less well-like umbilicus (lower whorls more evenly rounded) are distinctive. See key 1Q (**APPENDIX A**) for regional comparisons.

**Ecology:** This strong xerophile lives on relatively open mixed alluvial and limestone talus slopes. All are dry and poorly vegetated (largely open), with grasses and *Celtus* the most common species. Colonies are almost monospecific, with occasional individuals of *Allogona ptychophora ptychophora* the only other large land snail.

**Original distribution:** Probably confined to a portion of the lower Rapid River valley, Little Salmon River drainage, Idaho County, Idaho, east side of the Seven Devils Mountains, and absent from high elevations and moist lowland situations.

**Current distribution:** Known live from about three colonies in the lower Rapid River drainage. One or more appear to be on Nez Perce National Forest lands. For site details and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** Strict Idaho precinctive, confined to a minor portion of the Rapid River corridor, *i.e.*, another lower Salmon River drainage endemic.

**Specific Idaho sites:** The only three known sites are LSR 199-201.

**Threats:** The whole known range is heavily grazed, and colonies appear to be confined to fortuitously protected areas. Dead shells indicate former much more widespread occurrence. Colonies are on or near horse and foot trails into Rapid River back country; the slope with surviving sites has been sapped, possibly to provide material for the adjacent Idaho Power fish hatchery.

**Criteria for inclusion:** Very local endemic; impacts on all known sites. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This species has no special status at present. It should be regarded as Sensitive by state, federal (*e.g.*, Forest Service), or other land and wildlife Managers. We recommend [as stated originally in Frest & Johannes, 1995a, b] Federal and State (Idaho) listing as Endangered, due to the limited area of occurrence, known and predictable future impacts to all known sites, and other reasons cited above. Comprehensive recent surveys of the lower Salmon River and part of the Little Salmon River and Rapid River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is unlikely that many additional sites will be found.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Oreohelix* n. sp. 14
### limestone mountainsnail

**Type locality:** To be designated when species is described.

**Description:** Shell small-medium sized; maximum diameter at adulthood (5 1/2 whorls) about 13 mm; comparatively thin except for slightly thickened aperture. Spire very low, almost discoidal; whorls slightly convex; sutures deeply impressed; pronounced peripheral keel. Transverse ribs pronounced, widely spaced, cord-like, more or less regular; equal on both shell surfaces. Lower surface more convex; almost with basal angulation; umbilicus elliptical, well-like even though shallow and broad, about 1/3 shell diameter. Color bands faint-absent; shell ranges from slightly brownish to off-white, with transverse ribs often slightly lighter in color than interspaces. Aperture oblique, almost trapezoidal, sometimes barely adnate.

**Discussion:** This very striking species is a small member of the *Oreohelix intersum* group. Distinctive features are the low, almost discoidal shell; relatively prominent ribbing, strong peripheral keel, small size; and large umbilicus. *Oreohelix hammeri*, the only local snail with at all similar features, is much larger, has fewer, very large and low radial ribs; and a much smaller umbilicus. See key 1Q (**APPENDIX A**) for regional comparisons.

**Ecology:** A strong xerophile living on relatively open limestone outcrops and talus slopes. Sites are dry and poorly vegetated (largely open), with grasses, *Celtus,* and *Balsamorrhiza* the most common species. Colonies typically have occasional individuals of *Allogona ptychophora ptychophora, Oreohelix* n. sp. 13 (Rapid River mountainsnail), and *Cryptomastix* spp.

**Original distribution:** Probably confined to a portion of the lower Rapid River valley, Little Salmon River drainage, Idaho County, Idaho, east side of the Seven Devils Mountains, and absent from high elevations and moist lowland situations.

**Current distribution:** Known live from perhaps three nearby colonies in the lower Rapid River drainage. One or more appear to be on Nez Perce National Forest lands. For site details and map, see Frest & Johannes (1995a).

**Idaho distribution and comments:** This attractive taxon is a Rapid River (lower Salmon River drainage) corridor endemic, with the known sites within miles of each other.

**Specific Idaho sites:** All three (LSR 114 and 115 are the only two that can be confirmed live currently) are quite small colonies on a single limestone block.

**Threats:** The whole known range is heavily grazed, and colonies appear to be confined to fortuitously protected areas. Dead shells indicate former, much more widespread occurrence. Colonies are on or near horse/foot trails into Rapid River back country. Live individuals are rare at all sites, one of which is a rockpile only a few feet in width.

**Criteria for inclusion:** Very local endemic; impacts on all known sites. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Currently, this species has no special status. We first made the succeeding recommendations in Frest & Johannes (1995a). Minimally, it should be regarded as Sensitive by federal (*e.g.*, Forest Service) or other land and wildlife managers. Federal and State (Idaho) listing as Endangered is needed, in our opinion, due to the limited area of occurrence, ongoing threats to existing populations, and other factors discussed above. Comprehensive recent surveys of the lower Salmon River and part of the Little Salmon River and Rapid River drainages for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is unlikely that many additional sites will be found.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

### *Oreohelix* n. sp. 15
### speckled mountainsnail

**Type locality:** Will be designated when the species is formally described.

**Description:** A medium-large species, reaching a maximum diameter of 23 mm at 4 1/2-5 whorls. Spire depressed, sutures slightly impressed; weak peripheral keel visible in side view but aperture well-rounded. Shell comparatively thin; aperture not thickened parietal callus very thin; aperture not jugate. Color bands weakly developed; subperipheral very thin; supraperipheral band wider; upper whorl with light pinkish brown background color and well-developed irregular small white spots and blotches, roughly paralleling growth lines; growth lines slightly raised into irregular, thin but distinct transverse ribs; ribs generally streaked with white. Lower shell surface white; both surfaces with moderately well-developed striae, slightly stronger on upper surface. Umbilicus shallow, well-rounded; small, diameter about 1/5 maximum shell width.

**Discussion:** We listed this species under the same rubric in Frest & Johannes (1995a, b). See key 1Q (**APPENDIX A**) for regional comparisons. A member of the *jugalis* species group, differing from its better-known Idaho congener in size, shell color; apertural morphology; and relative umbilicus size.

**Ecology:** This *Oreohelix* is a comparative mesophile, occurring in steep mixed schist/ or conglomerate/alluvial slopes and taluses. Sites are generally north-facing; may be perennially moist due to seeps or springs; and are mostly at comparatively low elevations. Partly open *Pinus ponderosa* forest, with common small deciduous trees and extensive moss and grass cover, is a *desideratum* for this species. It is absent from relatively dry sites, even when the canopy is comparatively extensive. The most frequent large land snails found with this taxon are *Cryptomastix mullani clappi* and *Allogona ptychophora ptychophora*. Small land snails, such as *Vitrina limpida*, *Discus whitneyi*, and *Helicodiscus salmonaceus*, are frequent also. See Frest & Johannes (1995a) for site faunal lists and more details.

**Original distribution:** This species likely once was widespread in a limited portion of the River of No Return valley, from Riggins to French Creek Bridge, Idaho County, Idaho.

**Current distribution:** Survives at a few scattered colonies within the limits of its original range, mostly on the south side of the River of No Return, within the limited stretch indicated above. The species is rare live at all sites, and common finds of long-dead shells suggest a former, much more extensive population much reduced in recent years. Some known sites are on BLM and Payette National Forest sites. Additional sites on the north side of the River of No Return (Nez Perce National Forest and BLM public lands) are possible. For details on sites and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** A River of No Return endemic, occupying only a portion of that part of the lower Salmon River: a strongly precinctive taxon in an area long famous for land snail endemism.

**Specific Idaho sites:** Only 6: LSR 17, 18, 20, 192-194. Note that, as with many other lower Salmon taxa, these sites probably represent small remnants of a once-continuous, larger range.

**Threats:** The French Creek Road has had major impact on all existing sites. Occasional long-dead shells can be found in the road berms for a distance of several miles; but live colonies are very limited in area. Much of the area above the road has been heavily grazed, and snails generally survive only in the steepest and most unstable slope areas.

**Criteria for inclusion:** Local endemic; impacts to known sites; reduction in range and size of populations; occurrence on public lands. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. Older collections do not include specimens of this species. It is unlikely that many additional sites will be found. At present, this species has no special status; minimally, it should be regarded as Sensitive by federal (*e.g.*, Forest Service, BLM) or other land and wildlife managers. Federal and State (Idaho) listing as Endangered is needed, in our opinion (as previous work indicated: Frest & Johannes, 1995a, b), due to the limited area of occurrence, ongoing threats to existing populations, and other factors discussed above.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

### *Oreohelix* n. sp. 16
### rugose mountainsnail

**Type locality:** None designated as yet for this undescribed taxon.

**Description:** Large for genus (to 30 mm); adults 5 1/2-6 whorls. Shell biconvex in side view, nearly flat on upper surface; very strong and irregular pinched peripheral keel and rib. Early whorls slowly expanding, strongly convex upper surface and deeply impressed suture, protrusive peripheral keel appearing shortly after nepionic whorls. Later whorls more rapidly expanding, with 6-12 sharp but small ribs (lirae) on both surfaces, commonly interrupted by prominent but irregular growth lines, giving shell rugose appearance overall. Aperture subtrapezoidal in shape; generally thin, not at all or just slightly deflected; complete but thin across parietal wall. Lower surface with prominent basal keel; umbilicus wide, 1/3-nearly 1/2 shell diameter. Striation (actually, narrow raised lirae) well-developed on both surfaces between major lirae; most prominent on base. Typical *Oreohelix* color bands generally not developed; whole shell except raised lirae and keel often light pinkish-brown in color.

**Discussion:** This species, discussed under the same name in Frest & Johannes (1995a, b), is a member of the *haydeni* species group. The low whorl profile, rugose surface, basal keel, and extremely prominent peripheral keel are distinctive. The shell shape recalls such distantly related taxa as the southwestern US *Oreohelix metcalfi acutidiscus* but has no close Idaho parallels. The only other Snake-Salmon *Oreohelix* with a basal keel is *Oreohelix* n. sp. 17 [the bicarinate mountainsnail; *q.v.*], and this feature is rare in the genus generally. See key 1Q (**APPENDIX A**) for regional comparisons.

**Ecology**: This species occurs on north-facing, relatively dry and open steep slopes and shallow talus. The regolith is Triassic Martin Bridge Limestone; most of the area is grass-covered, but *Artemisia* and *Celtus* are locally common. The species generally occurs in scattered, sometimes rather dense monospecific colonies. A strongly xerophilic taxon; only dead shells were found in an area with an active, *Cornus stolonifera*-covered seep.

**Original distribution:** Probably widespread in the single creek drainage in which it now occurs. Dead specimens are common in many areas no longer occupied by live colonies, and the south-facing side of the drainage also lacks live specimens, although semi-fossil material is widespread.

**Current distribution:** Found as scattered colonies on one side of a single drainage in the south part of Hells Canyon, entirely on Payette National Forest lands, Allison Creek, Adams County, Idaho. This species may occur also on BLM lands at the mouth of the canyon; or in the Oregon stream drainage on the opposite side of Hells Canyon.

**Idaho distribution and comments:** This Idaho southern Hells canyon endemic is found only along one side of a single drainage, associated with a single accreted terrain block. The opposite side of the river has not been well-searched; but so far, there are no Oregon sites; and the lithology is quite strictly limited there also.

**Specific Idaho sites:** Only two, 209 and an unnumbered site. This likely also represents a once-continuous single colony. The limestone involved does not continue more than about 3/4 mi. up the creek. Much of the block has only dead shells currently.

**Threats:** Grazing is extensive in the range of this species, and the species is absent from heavily-grazed areas. Horse and walking trails also impact colonies, with dead shells [only] in such areas.

**Criteria for inclusion:** Very local endemic, confined to part of one drainage; reduction in numbers and area occupied; habitat damage; occurrence on public lands. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This very distinctive taxon has no status at present; minimally, it should be considered a Sensitive species by BLM, Forest Service, and other land management and wildlife agencies. As before (Frest & Johannes, 1995a, b), Federal and State (Idaho; Oregon, if it occurs there also) listing as Endangered is recommended, due to limited range, specialized habitat, habitat loss. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b): this taxon does not occur in the Lower Salmon area. We have also done recent survey work in Hells Canyon. Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is unlikely that many additional sites will be found.

**References:** Frest & Johannes (1995a); Deixis collections, 1990-1992.

### *Oreohelix* n. sp. 17
### bicarinate mountainsnail

**Type locality:** Will be designated when the species is formally described.

**Description:** A medium-sized (to 25 mm) species, generally with 5 1/2-6 whorls when adult. Shell biconvex, with strong, definitely protrusive peripheral keel and thick rib. Both surfaces with numerous equal fine lirae, interrupted by coarser growth lines, giving whole shell somewhat irregular outline and rugose appearance. Base with well-like umbilicus bordered by distinct basal carina; umbilicus width approximately 1/3 greatest shell diameter. Aperture generally thin, strongly oblique, subtrapezoidal in shape. Lower and upper peripheral bands generally distinct, wide, and dark brown; rest of shell light pinkish brown-white. Sutures on juvenile prominent, deeply impressed; adult whorls with only faint or obsolete sutures generally; some specimens with slightly disjunct later whorls; juveniles almost discoidal.

**Discussion:** Discussed in Frest & Johannes (1995a) under the same name. Anatomically, this species is a member of the *haydeni* complex. Shell characters agree with this assessment; but this species is unusual in two respects. The basal keel is seldom seen in adults in this genus (though universal in juveniles). Paedomorphosis occurs sporadically, however, throughout the *haydeni* group in particular and *Oreohelix* in general. The only other Idaho *Oreohelix* with a basal keel is *Oreohelix* n. sp. 16, which occurs nearby. However, that species has coarse transverse ribs, a strongly rugose surface, irregular and strongly protrusive peripheral keel and rib, no color bands, and low discoidal conch shape. Superficially, this species also *resembles Oreohelix strigosa goniogyra* (*q.v.*), in that both may be similar in size, have apparently strongly but finely lirate shell sculpture, and a moderate peripheral keel. Internal anatomy does not indicate close relationship: moreover, basal and juvenile shell features differ considerably, and the apparent fine ribbing in *goniogyra* turns out to be very strong spiral striation (incised lines, rather than fine raised ridges). See key 1Q (**APPENDIX A**) for regional comparisons.

**Ecology:** This species, a moderate to strong xerophile, is found in rather dry, south-facing rock talus (slightly metamorphosed limy breccia and conglomerate). Common plants include *Rhus horribilis*, grasses, *Celtus*, *Amelanchier*, and composites; locally, *Cystopteris*, *Artemisia*, bryophytes, and *Seligeria* are common also. Land snail associates include *Allogona ptychophora ptychophora* and *Cryptomastix* (*Bupiogona*) n. sp. 2 [Kinney Creek oregonian], as well as small taxa such as *Helicodiscus salmonaceus*. Interestingly, this species does not occur in the moist riparian talus close to Kinney Creek proper, where it is replaced by another *Oreohelix* species.

**Original distribution:** Probably widespread along two creek valleys in the vicinity of Kinney Creek, southern Hells Canyon, Adams County, Idaho, on BLM and Payette National Forest lands.

**Current distribution:** Limited to a few still-viable colonies along one side of Kinney Creek, southern Hells Canyon, on Payette National Forest and adjoining BLM lands. Could occur on the opposite side of Hells Canyon in Oregon, in that one valley there has the same rock unit exposed; but very limited prospects there, also.

**Idaho distribution and comments:** This taxon, like the preceding, is a south Hells Canyon endemic, very likely found only on the Idaho side of the Snake River. Again, the strict lithologic control provided by a single accreted terrain block of peculiar lithology, and occurring on only one side of Kinney Creek, presumably defines the total historic range. Only portions of the outcrop area are now suitable for land snails.

**Specific Idaho sites:** A single unnumbered site in the Kinney Creek drainage, Hells Canyon. Several small colonies are involved, scattered over about half a mile of outcrop area.

**Threats:** This valley has been heavily grazed. Consequently, colonies are limited to larger talus piles and small protected areas on steep slopes not as heavily grazed. The species is declining in area and numbers, with live individuals rare and large areas of talus with old, long-dead specimens only. In the unnamed valley to the south of Kinney Creek, only one small fortuitously-protected colony remains.

**Criteria for inclusion:** Very local endemic; past mining activities; present and past grazing restricting snail to protected areas; occurrence on public lands. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This species has no status at present. Minimally, it should be considered a Sensitive species by appropriate federal, state, and other land management and wildlife agencies. As before (Frest & Johannes, 1995a), Federal and State (Idaho; Oregon, also, if it should occur there) listing as Endangered is suggested, due to limited range and number of sites, ongoing threats. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b), without finding this taxon. We have also done recent survey work in Hells Canyon. Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is unlikely that many additional sites will be found.

**References**: Frest & Johannes (1995a); Deixis collections, 1989-1991.

### *Oreohelix* n. sp. 18
### Limestone Point mountainsnail

**Type locality:** None designated as yet; undescribed species.

**Description:** See Winslow (1920) for shell description. This species appears closely related to *Oreohelix idahoensis baileyi* and to *Oreohelix* n. sp. 20 (Sheep Gulch mountainsnail: *q.v.*). It differs from *baileyi* in that it is larger; more strongly turbiniform; has less convex whorls; and has a much narrower umbilicus. *Oreohelix* n. sp. 20 is much smaller; has much finer ribs; and has a still narrower umbilicus. This species has a distinct peripheral raised rib, as strong as, or stronger than, the radial ribs. In this feature it differs from *Oreohelix idahoensis baileyi*, *idahoensis idahoensis*, and *Oreohelix* n. sp. 20, all of whom have angular peripheries but much stronger radial ribs. *Oreohelix idahoensis idahoensis* has stronger radial ribs, a higher spire, and a proportionately much smaller umbilicus.

**Discussion:** Also listed under the current name in Frest & Johannes (1995a). See key 1Q (**APPENDIX A**) for regional comparisons. This form appears anatomically to be most closely similar to *Oreohelix idahoensis idahoensis,* based on Pilsbry (1934) dissections of specimens from Cottonwood Tree Creek [which he ascribed, incorrectly, to *Oreohelix idahoensis baileyi*: see discussion under that form] and Pilsbry's (1939), Solem's (1975), and our own work on *idahoensis idahoensis*.

**Ecology:** A strong xerophile, found on scattered limestone outcrops and talus. Associated vegetation is mostly grasses and sage scrub, with local scattered *Artemisia*, *Amelanchier*, *Prunus*, *Physocarpus*, and *Celtus*. Occurrence on limestone in sparse *Pinus ponderosa* forest has also been noted. Generally occurs alone or with *Cryptomastix populi*, *Oreohelix strigosa* subspp., and *Helicodiscus salmonaceus*. This species may be a calciphile.

**Original distribution:** Known with certainty from 2 sites in the north end of Hells Canyon: Limestone Point, Nez Perce County, Idaho; and Lime Hill, Asotin County, Washington. A third site is given as "Snake River Canyon, Idaho, eight miles below the mouth of the Salmon R." (Winslow, 1920). This would be in the vicinity of China Garden Creek, Craig Mountain, Nez Perce County, Idaho. Another old site was "Cottonwood Tree Creek, S. of Lewiston", Nez Perce County, Idaho. For discussion of this locality, see entry for *Cryptomastix populi.*

**Current distribution**: Known to survive at one site, Limestone Point. Probably restricted to a few sites within the original range in Washington, Idaho, and possibly Oregon. The large colony at Lime Hill, Asotin County, Washington [con-founded in Pilsbry (1939) with the Idaho Lime Point site, located on the opposite side of Hells Canyon] is now apparently extinct, due primarily to heavy grazing. This colony stretched over more than half a mile laterally, and many thousands of dead shells attest to former abundance. We did not find sites for this species in the nearby lower Salmon River Canyon (Frest & Johannes, 1995b).

**Idaho distribution and comments:** See above. The original range was probably rather small, but included three states where they come together in the northern portion of Hells Canyon.

**Specific Idaho sites:** A single live site at Limestone Point. Dead presumably Late Pleistocene/Holocene specimens are abundant at Lime Hill. We have been unable to relocate the remaining two historic sites (see above).

**Threats:** Heavy grazing in much of known area of occurrence; encroachment from nearby housing (Rogersburg, Washington); range fires; limestone quarrying.

**Criteria for inclusion:** Local endemic; decline in number of sites; past and ongoing threats; potential occurrence on public lands. Population trends (number of sites, number of individuals) are downward. Sites on Wallowa-Whitman National Forest; Nez Perce National Forest; BLM lands; and Hells Canyon National Recreation Area are possible.

**Recommended status:** This rather distinctive species has no status at present; minimally, it should be considered a Sensitive species by appropriate federal, state, and other land management and wildlife agencies. We recommend (just as in Frest & Johannes, 1995a) Federal and State (Idaho, Washington) listing as Endangered; the status of this taxon in Oregon is uncertain (no sites definitely survive). The species seems to be very local; and despite some protection anticipated for portions of its range, is unlikely to be completely secure, *e.g.,* from grazing. Two old sites are on private lands. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). We have also done recent work in Hells Canyon. Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is unlikely that many additional sites will be found.

**References:** Winslow (1920); Pilsbry (1939) [in part]; Frest & Johannes (1995a); Deixis collections, 1989-1990.

### *Oreohelix* n. sp. 19
### Shingle Creek mountainsnail

**Type locality:** Will be designated when the species is formally described.

**Description:** Shell small for genus; to 13 mm at 4 1/2-5 whorls (adult size); spire low conical; moderately impressed sutures; whorls convex; moderately distinct peripheral keel (but not a rib or pronounced); transverse ribs coarse, irregular, equally strong on both shell surfaces, Radial striation moderately developed on both sides. Color bands narrow but distinct, equal; small additional bands common on lower surface only; upper surface light reddish brown except for transverse ribs, which are generally white. Umbilicus moderately deep, somewhat well-like, about 1/4 maximum shell width.

**Discussion:** Listed previously under the same name (Frest & Johannes 1995a, b). Anatomically, this species is a member of the *intersum* species group. The shell features somewhat recall those of *Oreohelix waltoni*; but the juvenile sculpture differs considerably, as does the anatomy. The color pattern rib spacing, and spire height of the two also consistently differ. This small *Oreohelix* is probably most closely related to *Oreohelix intersum*; but is much smaller; has a lower spire; coarser and more widely spaced transverse ribs; transverse ribs equally strongly developed on the base; and a proportionately larger and deeper umbilicus despite the lower spire. Known colonies are quite consistent in morphology. See key 1Q, **APPENDIX A**, for regional comparisons.

**Ecology:** A comparative mesophile; found on rock (basalt) outcrops in shaded terrain at low elevations. Vegetation is rather moist Ponderosa pine forest with a well-developed understory, with grasses, bryophytes, and forbs diverse and common. Associated land snail species include *Cryptomastix mullani mullani*, *Allogona ptychophora ptychophora*, and *Discus whitneyi*.

**Original distribution:** Probably originally common in part of the Little Salmon River valley and major tributaries, Nez Perce National Forest, Idaho County, Idaho.

**Current distribution:** Survives at 3 small colonies in Shingle Creek and on the lower Salmon River, Idaho County, Idaho. One site is believed to be on Nez Perce National Forest and State of Idaho lands. For details on sites and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** A Little Salmon River, Idaho precinctive.

**Specific Idaho sites:** Only two live sites, LSR 197 & 198, rather separated from each other and very limited in extent.

**Threats:** Much of the surrounding area has been cleared and is heavily grazed by sheep. Low-elevation forest is now very rare in the Little Salmon and Lower Salmon drainages. Colonies have also been affected by road building (Rapid River Road). population trends, in terms of number of individuals and area occupied, are downward.

**Criteria for inclusion:** Local endemic, occurrence on public lands; past and ongoing threats.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho) listing as Endangered is appropriate for the reasons cited previously. Note that the same listing recommendations were made by Frest & Johannes (1995a, b). Comprehensive recent surveys of the lower Salmon and parts of the Little Salmon and Rapid River drainages for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is unlikely that many additional sites will be found.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1990-1993.

### *Oreohelix* n. sp. 20
### Sheep Gulch mountainsnail

**Type locality:** Has yet to be designated; taxon is undescribed.

**Description:** Shell low turbinate; whorls convex except for moderate peripheral angulation, rather narrow; 5-5 1/2 whorls in adult; last 1/2 commonly strongly deflected, sometimes almost disjunct as well; sutures deeply impressed. Aperture periphery sometimes rein-forced, especially across parietal margin; aperture oval, strongly oblique. Maximum diameter about 11 mm. Shell moderately-strongly ribbed, equally above and below; ribs somewhat irregular, spacing about half that of *Oreohelix idahoensis idahoensis*. Umbilicus well-like (periphery nearly angular), comparatively wide, about 1/4 maximum diameter. Shell unbanded; radial ribs whitish; interspaces brownish. Spiral striation weak as compared to *Oreohelix idahoensis idahoensis*.

**Discussion:** Same name here as in Frest & Johannes (1995a, b). See key 1Q (**APPENDIX A**) for regional comparisons. Shell shape and size in this taxon are somewhat similar to *Oreohelix waltoni*; but ribbing in that species is much less prominent; there is a distinct pigment pattern not present here; and *waltoni* is more depressed and has a much wider umbilicus. Comparisons with *Oreohelix idahoensis idahoensis*, the only other equally (or more) strongly-ribbed Idaho species have been made above; additionally shell shape and proportionate umbilical width are markedly different than in that species. Anatomically, this species is a member of the *idahoensis* species group.

**Ecology:** A strong xerophile, found in comparatively open areas with scattered limestone outcrops and talus; more rarely on limy schists. Associated vegetation includes grasses and *Artemisia*, with rare *Celtus*, common *Opuntia*, scattered buckbean. A probable calciphile. Associated land snails include rare *Allogona ptychophora*

*ptychophora* and one or more small *Cryptomastix* spp. A medium-elevation species; see Frest & Johannes (1995a, b) for further information.

**Original distribution:** A small area (probably *ca.* 15 mi.$^2$) near the lower Salmon River northeast, east, & southeast of Lucile. Colonies of this taxon generally occur at slightly higher elevations than nearby *Oreohelix idahoensis idahoensis* and *Oreohelix haydeni perplexa*. An old site which we have not recollected occurs on Nez Perce National Forest lands.

**Current distribution:** Found only in small areas of the original range well protected from grazing. For details and map, see Frest & Johannes (1995b). Occurrence on State of Idaho lands, Nez Perce National Forest, and BLM lands is quite possible.

**Idaho distribution and comments:** This taxon occupies a very limited range in the vicinity of Lucile, on a single weathered metasedimentary outcrop. A lower Salmon River corridor (and Idaho) strict endemic.

**Specific Idaho sites:** About 6 rather nearby live sites, LSR 59, 64, 134, 202, 203, 206.

**Threats:** The whole range of this taxon is currently heavily grazed, and the snails survive only in areas too rocky to be completely grazed out. This area also has scattered mines and prospects, and has been utilized for quarries and gravel pits also.

**Criteria for inclusion:** Local endemic; loss of habitat and range; ongoing threats. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This species has no status at present. Minimally, it should be considered a Sensitive species by appropriate federal, state, and other land management and wildlife agencies. Federal and State (Idaho) listing as Endangered should be undertaken, due to limited range and habitat loss. This suggested status dates to Frest & Johannes (1995a, b). Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is not likely that later work will greatly expand the range or result in location of substantial numbers of additional sites.

**References:** Pilsbry (1939); Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

## *Oreohelix* n. sp. 21
## Box Canyon mountainsnail

**Type locality:** To be designated when the species is described formally.

**Description:** Shell small-medium in size (maximum at 4 1/2-5 whorls 18 mm; some populations much smaller); low, depressed spire; whorls moderately convex; upper whorl surface often slightly stepped; moderately strong peripheral keel; sutures weakly impressed. Spiral striation strongly and consistently developed; growth lines distinct, regular, slightly raised, and fine on upper surface; lower surface much smoother. Lower color band thin but consistently present; upper band diffuse, sometimes not discernible; upper whorl often light brown; narrow white band on periphery. Aperture strongly oblique; often slightly deflected in last 1/8 whorl; commonly jugate; thickened; slightly flared all around except for parietal wall. Umbilicus moderately deep, round, with broadly rounded border; diameter about 1/3-1/4 maximum shell diameter.

**Discussion:** Originally listed under the same name in Frest & Johannes (1995a, b). This species somewhat resembles a miniature *Oreohelix* n. sp. 23 (Lucile mountainsnail). How-ever, it differs from that species in its smaller size, lack of a basal brown patch, angulate periphery, and prominent spiral striation, easily visible to the

unaided eye. It was present in old collections (dating to Henry Hemphill) in very small numbers, either unidentified or confounded with *Oreohelix jugalis*. Anatomy has not been completely worked out; but it appears to be related to the "*strigosa*" (*sensu* Pilsbry, 1939, not as defined herein) species group, rather than to the *jugalis* group. The closest Idaho relative would be *Oreohelix* n. sp. 23. For regional comparisons, see **APPENDIX A**, key 1Q.

**Ecology:** This species is found on metasedimentary outcrops and thin talus, generally at low elevations. A strong xerophile, it occurs in relatively open terrain, most often with grasses, *Celtus*, *Opuntia*, and local bryophytes and the common plant associates. Land snails which co-occur include *Allogona ptychophora ptychophora*, *Cryptomastix harfordiana*, and *Helicodiscus salmonaceus*; at one site, *Vallonia cyclophorella*, *Pupilla hebes*, *Cochlicopa lubrica*, and *Oreohelix waltoni* are close associates.

**Original distribution:** Probably relatively ubiquitous in the lower portions of a few ravines in the Box Canyon area, lower Salmon River drainage, Idaho County, Idaho. We did not find this species on the west side of the river, even near Box Canyon (see Frest & Johannes, 1995b for further details and map).

**Current distribution:** A few very small colonies in the immediate vicinity of Box Canyon, as above. At least one site is on BLM lands.

**Idaho distribution and comments:** See above. Another lower Salmon River corridor snail, completely restricted to schist outcrops on one side of the river. All sites are quite small and very limited in population, in good part due to road disturbance.

**Specific Idaho sites:** About 10 live sites: LSR 4, 7, 9, 40, 41, 130, 131, 165, 187, 188.

**Threats:** Most of the range has been severely affected by talus removal and road building along the US 95 corridor. Much of the area above the highway itself has been heavily grazed. The snails occur only in the few areas which still have talus or are too rocky for most cattle to traverse frequently. Mining was formerly extensive in this area; and some prospects are still worked nearby. The best remaining site could easily be removed for road material or fill, as has happened recently in this area (see, *e.g.*, entry for *Oreohelix jugalis*).

**Criteria for inclusion:** Very local endemic; occurrence on public lands; decline in habitat and numbers; ongoing threats. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Currently, this species has no special status. Minimally, it should be considered a Sensitive species by appropriate federal, state, and other land management and wildlife agencies. For the reasons cited above, Federal and State (Idaho) listing as Endangered is needed, as stated before in Frest & Johannes (1995a, b). Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1988-1994.

### *Oreohelix* n. sp. 22
### Slate Creek mountainsnail

**Type locality:** Will be designated when the species is formally described.

**Description:** Shell turbinate; low dome-shaped in first three whorls, more rapidly expanding and taller in final two whorls; adults (5-5 1/4 whorls) medium-sized, to 20 mm diameter. Shell moderately thick; ornamented with numerous fine, closely spaced, raised, slightly irregular growth lines (transverse ribs), often slightly coarser on upper surface. Spiral striation well-developed, evenly spaced, strong on both surfaces, intersecting transverse

ribs to give shell finely beaded appearance. Banding variably developed; the two peripheral bands thin, often not present; several irregularly spaced very thin bands on both upper and lower surfaces the most common pattern; these bands often interrupted or broken into mottles, purplish brown; upper surface often with purplish brown tinge throughout, stronger where bands intersect. Umbilicus narrow, less than 1/5-1/6 full shell diameter, deep, with well- rounded border. Aperture circular, slightly oblique, deflected slightly in last 1/8 whorl, generally slightly thickened, flared slightly where not in contact with earlier whorls.

**Discussion:** We used the same designation as here in Frest & Johannes (1995a, b). This species somewhat resembles the Utah-southeastern Idaho *peripherica* species group in general appearance. Anatomically, however, it appears related to the "*strigosa*" (in the traditional sense) species group. The low dome-shaped early whorls, later change in coiling parameters, and regular, narrowly-sized and -spaced radial ribs are distinctive features not shared with other "*strigosa*" group taxa. See key 1Q (**APPENDIX A**) for regional comparisons.

**Ecology:** This species is most common on moist, high-diversity *Pinus ponderosa* forest, with limestone outcrops and substrate but also with a well-developed duff layer. It occurs more sparingly in moist limestone and limy schist talus. Forests have a strong deciduous component, including *Physocarpus*, *Acer*, *Cornus stolonifera*, and other small trees and shrubs, as well as such understory plants as *Cornus canadensis*, *Pyrola* spp., *Linnaea*, *Viola*, bryophytes, and *Asarum*. Persistence of moisture is a *desideratum*. This species is a mesophile. The Slate Creek mountainsnail also appears to be a calciphile, confined to areas on or in the vicinity of a single "exotic terrain" limestone block (other such blocks in drainages to the north and south lack this species and have their own very distinctive endemics). It occurs at moderate elevations only. Associated larger mollusks include *Anguispira kochi occidentalis*, *Allogona* cf. *lombardii*, *Cryptomastix mullani* subsp., *Discus marmorensis*, *Discus "whitneyi"*, and *Hemphillia* cf. *camelus*. This species is absent from those portions of Slate Creek with basalt substrate.

**Original distribution:** Probably confined originally to a limited area (essentially, the outcrop area of one large exotic (accreted terrain) limestone block) in the middle Slate Creek drainage, lower Salmon River, Idaho County, Idaho.

**Current distribution:** Restricted to relatively unimpacted areas in the middle elevations of the Slate Creek drainage, including sites on Nez Perce National Forest, and probably on adjoining BLM lands as well. For details on sites and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** A strict Idaho endemic, limited to one side of a single accreted terrain block in the lower Salmon River drainage.

**Specific Idaho sites:** Four live sites: LSR 175-179.

**Threats:** Heavy grazing in lower part of areas of occurrence, where now confined to less cow-friendly talus; limestone quarrying, which has continued episodically to the present, with one recent round just concluded in 1994; road building (FS campground and Slate Creek access road). Dead shells indicate nearly ubiquitous former occurrence in the middle Slate Creek area; but heavily impacted areas, regardless of cause, have long-dead shells only; and this applies to the majority of the former range.

**Criteria for inclusion:** Very local endemic; specialized habitat; occurrence on public lands; declining numbers and habitat; past and ongoing threats. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** At present, this species has no status; minimally, it should be considered a Sensitive species by appropriate federal (Nez Perce National Forest, BLM) and state land management and wildlife agencies. Federal and State (Idaho) listing as Endangered is recommended, as was done also in Frest & Johannes (1995a, b). A local endemic now much reduced in numbers and area occupied and with continuing, clear threats. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other malacologists and collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and W. Walton. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Oreohelix* n. sp. 23
### Lucile mountainsnail

**Type locality:** To be designated when species is formally described.

**Description:** Shell large for genus, to 25 mm diameter at full adult size (5 1/2-6 1/2 whorls); moderately thick shell; comparatively tall conoid spire. Growth lines thin, irregular, fine, slightly stronger on upper surface; striation patchy, sometimes prominent for short stretches, often absent; surface overall rather smooth for the genus. Whorls slightly angular except for last; last whorl well-rounded, slightly inflated; deflected slightly as aperture approached; aperture slightly flared, thickened, commonly jugate, very oblique. Umbilicus moderate-sized, somewhat deep; well-rounded border; diameter about 1/3 maximum shell width. Color bands well developed, subequal; brown patch on lower surface at border of umbilicus; upper surface slightly brownish; typically extra bands seldom developed on either surface.

**Discussion:** This species (covered under the same name in Frest & Johannes, 1995a) is among the early finds of Henry Hemphill. It has been overlooked in collections, largely because of lack of specific locality data but also due to confusion with *Oreohelix jugalis* (Binney's (1890) figure of *"jugalis"* is this species; also reproduced in Pilsbry, 1939, as fig. 322c). It is more closely related anatomically to the "*strigosa*" species group than to the *jugalis* species group. It differs in shell features from the latter in that it is much taller; larger; more closely coiled, has an angular periphery; and has a brown pigment patch on the base. The only closely similar Idaho taxon is the Box Canyon mountainsnail (*q.v.*); but that taxon differs in several obvious features (see discussion under *Oreohelix* n. sp. 21 above; also see key 1Q (**APPENDIX A**) for additional regional comparisons). The very broad umbilicus and tall spire are unusual features for "*strigosa*" (in the sense of Pilsbry, 1939) species group taxa.

**Ecology:** This species occurs primarily near and in metasedimentary outcrops and small-scale talus, and occasionally in boulder piles above the high water mark. It is a relatively mesophilic taxon. Common plants are grasses, *Rhus horribilis*, *Celtus*, *Sorbus*, and *Balsamorhiza*. Land snails noted at the same sites as this species include *Cryptomastix harfordiana*, *Allogona ptychophora ptychophora*, *Helicodiscus salmonaceus*, and *Oreohelix jugalis*. This species once ranged onto the same alluvial slope as *Oreohelix waltoni* at the Lucile colony; but is now extinct at this site. The species is not found on limestone substrate (common near Lucile) or in very dry area, and hence does not occur, *e.g.*, in areas occupied by *Oreohelix idahoensis idahoensis* or *Oreohelix haydeni perplexa* very near Lucile.

**Original distribution:** Found on both sides of the lower Salmon River for several miles north and south of Lucile, on private and BLM lands, Idaho County, Idaho. For details, see Frest & Johannes (1995b).

**Current distribution:** Restricted to a few colonies in less-impacted area within the original range. Sites on BLM lands remain viable. See Frest & Johannes (1995b) for further information and map of sites.

**Idaho distribution and comments:** Occurs only in the vicinity of Lucile, on more than one substrate. A strict Idaho (mainstem Lower Salmon River drainage) precinctive.

**Specific Idaho sites:** Possibly as many as nine, all rather small and scattered through several square miles once almost certainly completely occupied, as a single large colony: 6, 8, 10, 11, 29, 35, 91, 97, 132.

**Threats:** Heavy grazing in much of area of occurrence; gold mining; road and human habitation construction along the US 95 corridor; talus and gravel mining. The snail is absent from heavily grazed areas. At least one mining claim within a colony's boundaries was being worked in 1992-1994. Dead shells from former colonies are

common along US 95 near Lucile. Mining operations have disturbed or removed many of the boulder-cobble areas along the banks of the lower Salmon River, while creating others. The mining discard piles, though some are quite old, have not been re-inhabited by this species.

**Criteria for inclusion:** Local endemic; occurrence on public lands; definable and ongoing threats; decline in habitat area and in numbers. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** As yet, this species has no special status. Minimally, it should be considered a Sensitive species by appropriate federal (*e.g.*, BLM) and state land management and wildlife agencies. Federal and State (Idaho) listing as Endangered is suggested [as was done also in Frest & Johannes, 1995a, b], for the reasons outlined above. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1988-1994;

### *Oreohelix* n. sp. 24
### Wet Gulch mountainsnail

**Type locality:** To be designated when species is described.

**Description:** Shell with low depressed spire, sometimes sublenticular; small (to 10 mm); generally 5 1/2 rather narrow whorls as adult; whorls with slightly convex sides; upper whorl surfaces somewhat stepped; sutures deeply impressed; periphery slightly angular and with distinct but narrow rib. Growth lines faint; moderately prominent, low, somewhat irregular transverse ribs on both surfaces, equally prominent on lower; fine raised spiral ribs (generally 5-7) on both upper and lower surfaces; spiral striation even faint but consistent over whorl surfaces. Shell thin; aperture moderately oblique, not thickened, not flared, slightly deflected in final 1/16 whorl. Color bands faint; peripheral bands sometimes absent; several faint bands sometimes present on either or both whorl surfaces, whole shell often very light tan, with several narrow white bands and thin, darker brown bands. Umbilicus about 1/4 shell diameter, deep, with well-rounded border; slightly elliptical.

**Discussion:** This species, because of its small size, convex whorls, low spire, and large umbilicus, somewhat resembles *Oreohelix waltoni*. However, that species has very different juvenile sculpture and anatomy; prominent radial ribs; and lacks transverse ribs. *Waltoni* is a member of the *idahoensis* species group; while anatomy indicates links between this species and the *haydeni* species group. For more complete regional comparisons, see key 1Q (**APPENDIX A**).

**Ecology:** This moderate xerophile is found on a largely open, dry, and exposed schist ridge and talus. Vegetation is sparse; but includes *Celtus* and grasses. This is the only large land snail found live, although recently dead specimens of both *Allogona ptychophora ptychophora* and *Cryptomastix harfordiana* occur in the vicinity. Long-dead *Oreohelix haydeni hesperia* were also noted; but these could be wash-down from farther up Wet Gulch.

**Original distribution:** Only known from one site as yet, near the mouth of Wet Gulch, lower Salmon River, Idaho County, Idaho. See Frest & Johannes (1995b) for details and site map.

**Current distribution:** Same as above.

**Idaho distribution and comments:** Only a single site; and that a tiny remnant, fortuitously protected. Unlikely to persist unless intervention and protection is attempted.

**Specific Idaho sites:** One only: LSR 31. This is obviously a critically endangered taxon.

**Threats:** This area has been heavily grazed, and live snails are confined to a narrow area protected by steep rocky terrain and the location of a fence line (the species is not found live on the other side of the fence line). The area has been damaged by fence line placement and is subject to landslides. Ownership is unclear; it may be within the US 95 right-of-way.

**Criteria for inclusion**: Extremely local endemic; past and ongoing threats, reduced colony size and numbers. Population trends (size and condition of site, number of individuals) are downward.

**Recommended status:** Currently this species has no special status; minimally, it should be considered a Sensitive species by appropriate federal (*e.g.*, BLM) and state land management and wildlife agencies. Federal and State (Idaho) listing as Endangered is suggested, for the reasons outlined above. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b), who made the same status recommendations: see also Frest & Johannes (1995a). Many other collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton, without finding other sites for this species. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Frest & Johannes (1995a, b); Deixis collections, 1994.

### *Oreohelix* n. sp. 25
### Stites mountainsnail

**Type locality:** Designation is deferred to the time when the species is formally described.

**Description:** Shell low dome-shaped, with faintly angular periphery and moderately convex sides; medium-sized, with up to 6 whorls, diameter to 20 mm. Aperture obliquely rounded, moderately oblique, slightly thickened; minor flare in last 1/16 whorl; slightly deflected typically. Shell moderately thick; principal color bands faint, sometimes interrupted; both whorl surfaces with varying amounts of purple-brown suffusion, but stronger on upper surface. Growth lines and spiral striation rather faint and irregular, equal above and below periphery. Umbilicus, small, well-rounded border, deep, about 1/5-1/6 maximum shell diameter, slightly elliptical.

**Discussion:** We listed this taxon under the same name previously (Frest & Johannes, 1995a). Anatomy of this species has been described by Solem (1975) under the name *Oreohelix strigosa strigosa*. See entry for *Oreohelix junii* (above) for discussion of the likely identity of this taxon. *Oreohelix* n. sp. 25 is characterized by a combination of size, spire shape, and the general rufous tint noted by Solem (1975). Comparisons between this taxon and sometimes co-occurring *Oreohelix vortex* were discussed at length by Solem (1975), who established beyond doubt that both are separate species. See key 1Q (**APPENDIX A**) for additional comparisons.

**Ecology:** This species is a moderate to weak xerophile, found typically in somewhat dry, open basalt taluses, often at low elevations. *Balsamorhiza*, *Celtus*, grasses, and *Sorbus* are common associates; but other taxa, such as *Salix*, *Populus*, *Sambucus*, *Rhus horribilis*, *Urtica*, and various composites occur at some sites. The most frequent co-occurring land snail is *Allogona ptychophora ptychophora*; but small *Cryptomastix* spp. and *Cryptomastix mullani mullani* may be common in the same taluses also; *Polygyrella polygyrella* and *Oreohelix vortex* were noted at one or more sites with this taxon.

**Original distribution:** Probably once one of the more common land snail species in the lower portions of the drainage of the South Fork Clearwater River and north of Lucile in the lower Salmon River valley, where these have basalt talus or substrate. This form has not been noted in the north portion of Hells Canyon, which also has extensive basalt outcroppings and rock piles, nor in the lower Salmon River valley south of Riggins (also basalt substrate).

**Current distribution:** Sporadically distributed within the original range. Many basalt taluses in the same general area have other species of *Oreohelix*, such as *jugalis* or *vortex*.

**Idaho distribution and comments:** This taxon has a fairly extensive range compared to others nearby: but the total is still remarkably small (probably less than 100 mi.$^2$). *Oreohelix* n. sp. 25 is sporadic within that area, being essentially confined to basalt taluses. An odd feature is that it seldom occurs with other *Oreohelix* species in the same talus, some of which also inhabit basalt taluses, so that not all taluses in the area suitable for inhabitation will have this species.

**Specific Idaho sites:** LSR 78-81; 83, 87, 98, 99, 102, 103, 107, 108, 125, 141, 145-151, 157-162, 191; thus about 28 live sites.

**Threats:** Talus mining and road improvements (one such, near White Bird in 1994, has almost completely destroyed perhaps the largest known site, and long-term survival here is unlikely); grazing; location of human habitations and roads.

**Criteria for inclusion:** Local endemic; past and ongoing threats; occurrence on public lands, including BLM, Nez Perce National Forest, and Nez Perce Tribe parcels. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** Presently, this species has no special status; minimally, it should be considered a Sensitive species by appropriate federal (*e.g.*, BLM) and state land management and wildlife agencies. Federal and State (Idaho) listing as Threatened is suggested (reiterated from Frest & Johannes, 1995a), for the reasons outlined above. Comprehensive recent surveys of the lower Salmon River drainage and adjacent parts of the lower Clearwater River drainage for this and other land snail species were conducted by Frest & Johannes (1995b), who also made the same status recommendations. Many other collectors (both professional and amateur) have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Solem (1975); Frest & Johannes (1995a, b); Deixis collections, 1989-1994.

## *Oreohelix* n. sp. 27
## Pass Creek mountainsnail

**Type locality:** Will be designated when the species is described.

**Description:** Shell medium-sized for genus (to 17 mm); adult with 5 1/4 whorls; moderately high turbinate spire; moderately thick; aperture rounded, slightly flared; very oblique, deflected in last 1/8 whorl slightly; columellar lip reflected slightly over umbilicus. Transverse ribs irregular, strong, crowded, varying widths, equal on both whorl surfaces; spiral striation strong but irregular, beading surface in some areas, equal above and below periphery. Color bands not developed; shell irregularly mottled with brown; ribs mostly white; surface as a whole appears rugose, but slightly glossy. Umbilicus deep, circular, with well-rounded border, narrow, about 1/9 full shell diameter.

**Discussion:** We first used this name in Frest & Johannes (1995a). Utah *peripherica* group taxa mostly are lower, have a slight peripheral keel; and the transverse ribs are narrow, more regular, and more widely spaced (interspaces are distinct and exceed rib width). The umbilicus of *peripherica* is proportionately larger also.

**Ecology:** Found in dry limestone terrain at a moderate elevation. The site is open and grassy; sage scrub is the dominant vegetation type locally. The slope is steep and south-facing. This species appears to be a xerophile and calciphile. No other land snails were noted in the vicinity.

**Original distribution:** Lost River Range, Challis National Forest, Custer County, Idaho.

**Current distribution:** Known from a single site in the Pass Creek drainage, Custer County, Idaho. Sites in adjacent Butte County are possible also.

**Idaho distribution and comments:** Apparently, a southeastern Idaho greater Wasatch Range (Lost River Range) endemic.

**Specific Idaho sites:** As single site, as described above.

**Threats:** The site is heavily grazed; and snails were found only under an overhang partly protected from grazing by its location.

**Criteria for inclusion:** Local endemic; occurrence on public lands; current threats to only known site.

**Recommended status:** This species has no special status at present. Minimally, it should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. On present, rather limited evidence, it probably should be listed as Endangered Federally and in Idaho; but more survey work needs to be done in the Lost River Range. We do not recommend listing at this time, following Frest & Johannes (1995a).

**References:** Frest & Johannes (1995a); Deixis collections, 1990.

### *Oreohelix* n. sp. 28
### quartzite mountainsnail

**Type locality:** None designated as yet; undescribed taxon.

**Description:** Shell depressed, discoidal, greenish-yellow, thin; moderate size, to 16 mm as adult (4 1/2-5 whorls; moderately rapidly expanding. Peripheral angulation sharp, but not strongly produced; peripheral lira only moderately strong. Single medium-width strong lira on upper surface; 5-7 on lower; numerous fine lirae on both surfaces, but interrupted sporadically by moderately strong growth lines, particularly well-developed on upper surface. Umbilicus deep, but not bordered by basal keel; somewhat narrow, about 1/5 full shell diameter. Aperture sub-trapezoidal, moderately oblique; peristome only slightly expanded at columella, slightly or not at all thickened. Color bands absent.

**Discussion:** This species, discussed in Frest & Johannes (1995a) under the same name, most closely resembles the Salmon River *Oreohelix* n. sp. 8 in color and shell shape, but that species is smaller, has prominent periostracal fringes (completely absent here), and a proportionately shallower and wider umbilicus. For other comparisons, see entry for Papoose Creek mountainsnail above. A member of the *Oreohelix haydeni* species group.

**Ecology:** Found thus far only in a large-scale, Ordovician-age, south-facing quartzite talus (with relatively calcareous soil, however). Common plants included grasses, scattered *Pinus*, *Celtus*, *Sorbus*, *Rhus*, *Artemisia*, and composites. This was the only large land snail present, although other *Oreohelix* species occur in the vicinity. The occurrence on quartzite is somewhat unusual.

**Original distribution**: Probably limited to portions of the northern Portneuf Range, Bannock County, Idaho.

**Current distribution:** A single colony above Lava Hot Springs, Bannock County, Idaho. Searches in the vicinity (1991, 1993, 1994) located other *Oreohelix* colonies, but no others of this species. It could occur on adjoining portions of Caribou National Forest, although it is not likely that later work will greatly expand either the range or number of sites.

**Idaho distribution and comments:** The quartzite occurrence is unusual for this genus, and nearby sites have other species. A greater Wasatch Range (Portneuf Range) endemic.

**Specific Idaho sites:** Only one site, as above.

**Threats:** This area is heavily grazed. The talus also has been modified to protect the Union Pacific Railroad tracks, which run along the base. Dead specimens of this species are common throughout the talus; but live specimens are very rare and confined to very limited and most favorable areas. We have only seen a few live specimens despite searches under optimum conditions.

**Criteria for inclusion:** Local endemic; current and past threats; possible occurrence on federal lands (Caribou National Forest). Population trends, as evidenced from areal reduction of the only known site, and small number of live *vs.* dead individuals noted in several visits, are downward.

**Recommended status:** This species has no special status at present; minimally, it should be considered a Sensitive species by appropriate federal and state land management and wildlife agencies. We recommend Federal and State (Idaho) listing as Endangered, for the reasons outlined above. Recent (1991-1994) searches of the Lava Hot Springs area and elsewhere in southeastern Idaho by us produced no other sites. The same status recommendations were made in Frest & Johannes (1995a).

**References:** Frest & Johannes (1995a); Deixis collections, 1991-1994.

## *Oreohelix* n. sp. 29
## Hells Canyon mountainsnail

**Type locality:** Will be designated when the species is described.

**Description:** Shell medium-sized for genus, to 20 mm; adult with 4 1/2-5 1/2 whorls; low turbinate in shape, slowly expanding, with low, almost flat, initial whorls. Shell moderately thin; aperture definitely reinforced, slightly deflected, not strongly oblique; distinctly flared, and slightly reflected over umbilicus. Growth lines faint on adult whorls, low, widely spaced, irregular; lower surface almost smooth; spiral striation absent on mature whorls; surface dull or with slight sheen. Two principal color bands thin but almost always present; secondary bands uncommon; shell generally chalky off-white, except for faint brown suffusion above upper color band. Umbilicus small, deep, well-rounded border; elliptical; diameter about 1/5-1/6 total shell width.

**Discussion:** Listed the same in Frest & Johannes (1995a). See key 1Q (**APPENDIX A**) for regional comparisons. This medium-sized species somewhat resembles taxa from other parts of the range ascribed by Pilsbry (1939) to *Oreohelix strigosa depressa*. It differs from type material and other lots from CO in that it is higher; has fewer and more convex whorls; has a smaller umbilicus; and generally lacks spiral striation. Anatomically, it is a member of the "*strigosa*" (as used in Pilsbry, 1939) species group.

**Ecology:** A strong xerophile, found on several lithologies in sage scrub; but particularly common on limestone. Most colonies occur in small-scale, north-facing talus or rock piles. Common associates include *Artemisia*, *Balsamorrhiza*, grasses, *Celtus*, *Opuntia*, and *Rhus horribilis*. More frequent large land snails found with this species include *Allogona ptychophora ptychophora*, *Cryptomastix populi*, and additional small *Cryptomastix* species. This species generally occurs at lower elevations in major stream valleys.

**Original distribution:** Probably quite common along the middle and northern parts of Hells Canyon, the Snake River Canyon to a point a few miles west of Clarkston, Washington; and along the lower few miles of the Grande Ronde River. In the southern portion of Hells Canyon, *i.e.* Seven Devils Mountains and south, this species is replaced by others. This taxon appears to have been utilized as a food resource by early aboriginal peoples in Hells Canyon.

**Current distribution:** Scattered sites within the original range, including Nez Perce National Forest (*e.g.*, the vicinity of Pittsburg Landing), Wallowa-Whitman National Forest, Hells Canyon National Recreation Area, and Snake Wild and Scenic River: narrow portions of Idaho and Nez Perce counties, Idaho; Asotin and Whitman counties, Washington; and Wallowa County, Oregon.

**Idaho distribution and comments:** About one-quarter to one-third of the total distribution occurs in Idaho (northern Hells Canyon).

**Specific Idaho sites:** There are about 12 sites known, of which four are in Idaho: LSR 86, 88, 89, 90.

**Threats:** Trail and road development in Pittsburg Landing area; heavy grazing in most of its range; development on inholdings in the northern Hells Canyon area; road building and maintenance in the Clarkston area (*e.g.*, colonies along US 12 have been extirpated in the last few years); suburban expansion of Clarkston, Washington and Lewiston, Idaho. Populations are declining in terms of absolute numbers and number of sites. It is not likely that later work will greatly expand either the range or number of sites.

**Criteria for inclusion:** Local endemic; past and current threats (as outlined above); loss of historic sites; declining numbers; occurrence on public lands.

**Recommended status:** This taxon has no special status at present. Minimally, it should be regarded as a Sensitive species by the relevant Forest Service, BLM, and state land management and wildlife offices. We recommend Federal and State (Idaho, Oregon, Washington) listing as Threatened, for the reasons discussed previously: the same recommendations were made by Frest & Johannes (1995a, b).

**References:** Deixis collections, 1988-1994; Frest & Johannes (1995a, b). Old specimens of this taxon are in museum collections (*e.g.*, ANSP).

### *Oreohelix* n. sp. 30
### Pittsburg Landing mountainsnail

**Type locality:** To be designated when the species is formally described.

**Description:** Shell small-medium sized (to 13 mm); adults with 5-5 1/4 evenly spaced, convex, rather closely coiled whorls. Shell moderately thin; sutures somewhat impressed; no peripheral keel, angulation, or rib. Transverse ribs moderately prominent, sometimes broad, fairly regular, interspaces less wide than ribs; equal above and below periphery; growth lines in interspaces; spiral striation very patchy, mostly on broader ribs. Color bands always present; both thin rest of shell off-white, generally with faint brownish blotches, particularly on upper whorl and in interspaces; transverse ribs white. Aperture rounded, slightly deflected and flared in last 1/16 whorl, slightly reinforced. Umbilicus deep, narrow, and well-like; periphery rounded, abrupt border; diameter about 1/6 maximum shell diameter.

**Discussion:** This species was discussed earlier under the same rubric (Frest & Johannes, 1995a). It has a shell shape somewhat similar to that of *Oreohelix idahoensis idahoensis*; however, the umbilicus is larger; spiral striation is not well developed; the radial ribs, though prominent, are narrower and more narrowly spaced; and the two typical color bands of *Oreohelix* (absent in *idahoensis*) are well developed. This species also lacks a peripheral

keel, rib, or angulation. It also bears some resemblance to coarser-ribbed members of the *peripherica* species group, such as *Oreohelix peripherica newcombi* and *Oreohelix peripherica wasatchensis*; but this Idaho-Utah group has no members in western Idaho, and is anatomically somewhat close to *Oreohelix strigosa depressa* (*s.l.*). Anatomically, the Pittsburg Landing mountainsnail is a member of the *idahoensis* species group. Aside from this, it differs from the Utah snails in that both have very narrow umbilici; *wasatchensis* is much larger, has pyramidal upper whorls, and has a strong peripheral keel. *Newcombi* is similar in size, ribbing, and color banding; but this species is taller, has very different juvenile whorls, and a descending aperture. For regionally-oriented comparisons, see key 1Q (**APPENDIX A**).

**Ecology:** Confined to small talus piles and the base of a sharp cliff face; apparently a calciphile, as nearby schist outcrops lack the species. Vegetation is sage scrub, mostly replanted with grasses. Scattered *Celtus*, *Balsamorrhiza*, and *Sorbus* were noted locally. A strong xerophile.

**Original distribution:** Known only from a single colony in the Pittsburg Landing area, Nez Perce National Forest, Idaho County, Idaho.

**Current distribution:** Very narrow (<12" wide) area along part of cliff base and scattered talus remnants in the same area. The species has invaded part of an old stone fence, now collapsed to rock piles, and a pioneer grave site.

**Idaho distribution and comments:** We have not found this species on the other side of Hells Canyon or at other sites in the vicinity. A critically endangered Idaho Hells Canyon endemic taxon.

**Specific Idaho sites:** A single site in Nez Perce National Forest.

**Threats:** Heavy grazing has extirpated the colony over much of the original site, so that only dead shells were noted in most areas in several visits. The portion of the colony on the west side of Kurry Creek (most of it) was destroyed by excavation for road fill and "improvements". Some of this took place in 1993, after we had informed the Forest Service of the location of this colony and its significance (letter of 2/26/91 to E. Cole, Hells Canyon National Recreation Area; copy to R. Mason, Wallowa-Whitman National Forest); some similar work had been done earlier. The 1993 road improvements caused substantial erosion in the lower reaches of Kurry Creek, cutting into the area now and formerly occupied by the snail. Dead shells are still (1994) common in this area, indicating the former extent of the colony. Populations are declining in terms of absolute numbers and area occupied. It is not likely that later work will greatly expand either the range or number of sites. The sole known site is likely to see much greater human traffic as a result of recent Forest Service work to "improve" the road and increase access to Pittsburg Landing. Access increase has already resulted in vandalism to Native American petroglyphs. Landslides have also occurred in the Pittsburg Landing area (Vallier & Miller, 1974); and recent road modifications may exacerbate this problem.

**Criteria for inclusion:** Local endemic; past and current threats (as outlined above); reduction in area of only known site; declining numbers; occurrence on public lands.

**Recommended status:** This taxon has no special status at present. Minimally, it should be regarded as a Sensitive species by the relevant Forest Service, BLM, and state land management and wildlife offices. We recommend Federal and State (Idaho) listing as Endangered, for the reasons discussed previously. There is sufficient recently-collected information, and recent survey work, to support this action.

**References:** Frest & Johannes (1995a); Deixis collections, 1991-1994.

### *Oreohelix strigosa goniogyra* Pilsbry, 1934
### striate mountainsnail

**Type locality:** "On lower Race Creek below forest, 1/4 mile from the mouth and 2 miles north of Riggins, Idaho" (Pilsbry, 1939); holotype ANSP 158421a. Pilsbry (1939) cites the original description as dating from 1933; but the cover of separates includes the line "Published March 3, 1934".

**Description:** See Pilsbry (1934, 1939) for description of both shell and anatomy. This is a medium-large sized taxon (to 25 mm diameter at 5 1/2 whorls), with a definite peripheral keel extending to the aperture, and fine but strong spiral striation (relatively even and regular incised lirae) developed over the whole teleoconch, but becoming weaker on the base; whorls somewhat flattened, often giving spire dome- or low beehive-shape; suture narrow but deeply impressed; final 1/8 whorl often deflected; aperture slightly expanded, slightly thickened; shell thick; color bands variable; often faint or absent; primary bands also often obsolete on teleoconch. For further details, see Frest & Johannes (1995a, b).

**Discussion:** Cited the same here as in Frest & Johannes (1995a, b). No other species in the "*strigosa*" species group has a strongly carinate adult shell with prominent spiral lines. This species superficially somewhat resembles the bicarinate mountainsnail (*Oreohelix* n. sp. 17); but the basal carina, fine ribs rather than incised lines, and *haydeni* species group anatomy are obvious *differentiae*. For regional comparisons, consult **APPENDIX A**, key 1Q. As Pilsbry (1939) established, this taxon is closely related to *strigosa* as he defined the species.

**Ecology:** This snail is found mostly on forested outcrops (*Pinus ponderosa* forest), with lithologies ranging from greenish schist to limestone. Commonly, sites have a partly-completely closed canopy and diverse forb and deciduous understory. Reported colonies have substantial faunas, including *Polygyrella polygyrella*, *Cryptomastix mullani mullani*, *Allogona ptychophora ptychophora*, *Anguispira nimapuna*, and *Hemphillia camelus*. One site is also the type locality for *Allogona lombardii*. The elevation range for this species is considerable. Material from the type colony on lower Race Creek seldom exceeds 19 mm in diameter; higher elevation sites have individuals in the 25 mm range commonly.

**Original distribution:** Originally reported from the Race Creek drainage, lower Salmon River valley, Idaho County, Idaho. Subsequently, Smith (1943) recorded sites also from the Selway River (Clearwater River) drainage. Taxonomy of specimens from the Selway sites needs to be verified.

**Current distribution:** May be limited to a few remnant colonies in the Race Creek drainage. Taxonomy of the Lake Creek populations is uncertain at this point. The type locality has been grazed out (now in a horse pasture); but a colony remains nearby, presumably on public (BLM) lands and protected on one side by a fence. For site details and map, see Frest & Johannes (1995b). We and private collectors have revisited Smith's (1943) two Selway River sites and others in the vicinity recently, but did not find this species. These sites are on Nez Perce National Forest lands.

**Idaho distribution and comments:** Seemingly confined to the Race Creek drainage; and there only in two major tributary valleys. An Idaho and lower Salmon River endemic

**Specific Idaho sites:** Perhaps six sites in two somewhat separated drainages: LSR 20, 94, 181-183, 194.

**Threats:** Grazing; logging in both the Selway and Lower Salmon valleys, road location and modifications; forest fires. The colonies along the upper part of the Race Creek drainage were huge, judging by dead shells, which number in the millions. Relatively recent clear-cutting and fire have reduced these sites in Nez Perce National Forest to small remnants, with the snail mostly surviving in rocky areas offering some refuge from summer desiccation. Population trends (number of sites, number of individuals) are downward.

**Criteria for inclusion:** Local endemic; past and continued threats, as noted above; occurrence on public (National Forest and BLM) lands.

**Recommended status:** Until recently this taxon was a federal C2 candidate (USFWS, 1994). It should at least be considered a Sensitive species by Forest Service and other federal and state land and wildlife agencies. We

recommend Federal and State (Idaho) listing of this taxon as Endangered, as we did in Frest & Johannes (1995a, b). Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other collectors, both professional and amateur, have worked this area for over 130 years, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is not likely that later work will greatly expand either the range or number of sites.

**References:** Pilsbry (1934, 1939); Smith (1943); Frest & Johannes (1995a, b); Deixis collections, 1989-1993.

### *Oreohelix strigosa* n. subsp. 1
### Nez Perce mountainsnail

**Type locality:** To be established when the species is formally described.

**Description:** Shell large, low, depressed, 5-6 whorls, diameter to 30 mm; moderately thick; whorls convex, sutures only slightly impressed; slight peripheral keel occasionally; accentuated in last half whorl only. Growth lines very fine, low, moderately regular, crowded; spiral striation strong, striae moderately widely spaced, crossing growth lines to produce finely reticulate pattern not visible to naked eye; surface appears somewhat smooth. Aperture rounded, not reinforced, moderately oblique. Umbilicus moderate in size and depth, border well-rounded, circular, about 1/3 maximum shell diameter. Color bands generally present; subsidiary bands variable in size and position; shell ground color off-white, generally with varying amounts of purple-brown or purple-red suffusion or mottles or both, especially on top surface.

**Discussion:** Under this name also in Frest & Johannes (1995a, b). This large-sized taxon appears from shell and anatomical features to be a member of the "*strigosa*" (in the sense of Pilsbry, 1939) species group. Distinguishing teleoconch features are the low spire, fine growth lines, and prominent and consistent spiral striae. For regional comparisons, consult **APPENDIX A**, key 1Q.

**Ecology:** This mesophilic taxon is found exclusively in moderate-high elevation *Pinus ponderosa* forests, generally in areas with some rock exposure. It has been noted primarily on limestone; but occasionally on basalt as well. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.,* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum.* Common associates are *Physocarpus*, *Prunus*, soapberry, and bryophytes. Sometimes found with such taxa as *Allogona ptychophora ptychophora*, *Anguispira kochi occidentalis*, *Cryptomastix mullani mullani*, and *Radiodiscus abietum.* This species is not as sensitive to disturbance as, *e.g.*, *Hemphillia camelus*; but is absent from severely grazed or otherwise heavily disturbed areas. It does not seem to prefer talus situations, although sometimes found there. See Frest & Johannes (1995b) for further information.

**Original distribution:** Probably very widespread in medium-high elevations in the Seven Devils Mountains area, Nez Perce and Payette National Forest; in undisturbed sites it is the most frequently encountered large land snail. It is now absent from the vast majority of its range, where long-dead shells often still attest to its former occurrence.

**Current distribution:** Restricted to relatively undisturbed sites in Nez Perce National Forest; particularly those with limestone or other calcium-rich substrate. See Frest & Johannes (1995b) for some specifics. This species was mostly overlooked by earlier collectors, because of access problems in high portions of the Hells Canyon-lower Salmon River area. Still, at least one historic site (along Squaw Creek) is known to have been extirpated (see Frest & Johannes, 1995b for discussion).

**Idaho distribution and comments:** This taxon appears to be somewhat more broadly distributed than most lower Salmon River drainage species; but is still quite limited compared to the great majority of animal species.

**Specific Idaho sites:** So far, 6 live sites: LSR 56, 152, 176, 177, 179, 180.

**Threats**: Severe grazing; logging; severe forest fires; road building and maintenance.

**Criteria for inclusion:** Local endemic; habitat reduction and possible site loss through-out range. Population trends (number of sites, number of individuals) are downward. It is not likely that later work will greatly expand either the range or number of sites.

**Recommended status:** This taxon has no special status at present; it should at least be considered a Sensitive species by Forest Service and other federal and state land and wildlife agencies. We recommend consideration of federal and State (Idaho) listing of this taxon as Threatened (as we did previously in Frest & Johannes, 1995a, b). Extensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other collectors have worked this area, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton, from the 1860s to the present; a few old records indicate more widespread former occurrence.

**References:** Frest & Johannes (1995a); Deixis collections, 1990-1994.

### *Oreohelix tenuistriata* Henderson & Daniels, 1916
### thin-ribbed mountainsnail

**Type locality:** A canyon between Lava Hot Springs and McCammon, about 2 mi. southwest of Lava Hot Springs, on the south side of the Portneuf River, Bannock County, Idaho. Holotype UI 18602; paratype ANSP 112801, UCM 6497; some later-collected specimens (UI 18603) referred to this species by Pilsbry (1939) are another form of *Oreohelix*. See also UCM 7151, 7152. See Wu & Brandauer (1982) for UCM types.

**Description:** Cited identically by Frest & Johannes (1995a). The best description and illustration are those of Pilsbry (1939); see also Henderson & Daniels (1916, 1917) and Pilsbry (1917). This taxon has a thin shell, generally moderately conoid in shape, with convex, well-rounded whorls; the umbilicus is small and deep, only 1/5-1/6 the total shell diameter; the shell is small (*ca.* 10-13 mm diameter at 5 1/2 whorls). mature ornament consists of numerous fine, sharp, slightly wavy retractive ribs crossed by indistinct, low spirals. Those on the base are more distinct and commonly vary from 6-8 in number. The aperture is rounded angulate, oblique, and not usually deflected or reinforced noticeably.

**Discussion:** We have examined a fair number of museum specimens of this species and find that the well-rounded form is distinctive and typical, *contra* Pilsbry (1940, p. 478), with the later collection with an angular periphery representing another species [and, not incidentally, from a different site]. As opined by Pilsbry, this is a member of the *haydeni* species group, with the distinct fine striae and small, relatively rounded whorls distinguishing features not readily compared to other *haydeni*-group taxa, especially in Idaho.

**Ecology:** The type locality is said to be a canyon, with the snails occurring "under shrubs and mats of the radical leaves of *Balsamorrhiza sagittata* (Nutt.), overhanging small piles of limestone in open places among the mountain mahoganies" (Henderson & Daniels, 1916). The available information suggests a low-elevation xerophilic and probably calciphilic taxon.

**Original distribution:** Known only from the type locality. Other species of *Oreohelix*, including members of the *haydeni* and "*strigosa*" species groups, still occur in the same general area.

**Current distribution:** Uncertain. We have made several unsuccessful attempts to locate a live population of this species in the area between Lava Hot Springs and McCammon, 1991-1994.

**Idaho distribution and comments:** A small portion of the Portneuf River valley. Other species occupy the same habitat in most of the Portneuf. This species could now be extinct.

**Specific Idaho sites:** The literature implies two sites: but examination of museum lots seems to indicate that Henderson & Daniels were merely describing the same site in slightly differing ways: see Henderson & Daniels (1916, 1917).

**Threats:** Much of the potential area of occurrence is heavily grazed. Limestone areas have been affected by road construction (especially US 30), railroad construction (Union Pacific Railroad), and expansion of Lava Hot Springs and its associated resorts.

**Criteria for inclusion:** Very local endemic; failure to find additional populations and to relocate the only previously-known site; possible occurrence on State of Idaho, BLM, or Forest Service lands in this area. It seems likely that population trends are downward. Sites for this taxon may remain elsewhere in the Portneuf Range. However, it is not likely that later work will greatly expand either the range or number of sites.

**Recommended status:** At present this species has no special status. It should at least be considered a Sensitive species by Forest Service and other federal and state land and wildlife agencies. We recommend federal and State (Idaho) listing as Endangered (as we have done before: Frest & Johannes, 1995a), as there is sufficient recently-collected information, and recent survey work, to support this action.

**References:** Henderson & Daniels (1916, 1917); Pilsbry (1917a, 1939); Frest & Johannes (1995a).

### *Oreohelix vortex* Berry, 1932
### whorled mountainsnail

**Type locality:** "Salmon River, White Bird, Idaho, Co., Idaho"; holotype SSB 7283; paratypes SSB 4655; holotype of *Oreohelix flammulifer* Berry, 1932, a synonym, SSB 7284, paratypes SSB 4656 (same type locality). For probable location of this site, see Solem (1975) and Frest & Johannes (1995b).

**Description:** The best shell description and illustration are by Pilsbry (1939); but see also anatomy and illustrations in Solem (1975). This species, another Hemphill discovery, does not closely resemble any other Salmon River *Oreohelix* species. Whorls 5 1/4-5 1/2 at diameter of about 13-15 mm, rather slowly expanding; shell rather thin; spire low conoid; sutures deeply impressed; periphery subangulate to last whorl, where commonly rounded or subrounded in last half whorl; aperture ovate, slightly descending, strongly oblique; not thickened. Shell sculpture of moderately coarse growth lines and fine but distinct spiral striae, with very low periostracal fringes on about 1/5, especially noted on base; commonly rubbed off on dead or museum specimens. Periostracum often purplish over upper spire, sometimes flammulated instead of continuous, sometimes expending somewhat below periphery; base usually lighter gray-brown. Umbilicus shallow, completely open, wide for genus, contained about 3 1/2 times in shell diameter.

Distinctive shell features are the rather close coiling, fine periostracum-fringed lirae, impressed sutures, and wide umbilicus. It was first discovered in the same period as many other Salmon River species (1860-1880); but like many, remained undescribed until much later. Pilsbry had Hemphill-collected specimens of this species at ANSP for many years prior to its description under *abavia* (a *nomen nudum*); other such specimens are at CAS and in our collections.

**Discussion:** We cite this taxon here as in Frest & Johannes (1995a, b). Pilsbry (1939) synonymized *vortex* and *flammulifer* and regarded this taxon as a subspecies of *jugalis*: anatomical data were not available for any of the three when he made this call. With this additional information, it is clear that *vortex* is a full species not particularly closely related to *jugalis*; while *flammulifer* is a synonym, as Pilsbry surmised (Solem, 1975). See also Frest & Johannes (1995b) and key 1Q (**APPENDIX A**) herein for regional comparisons.

**Ecology:** A xerophile, restricted mostly to large-scale basalt taluses. Sites are typically rather dry and open. Most common vegetation is grasses; at some sites, *Balsamorhiza*, *Artemisia*, *Celtus*, *Rhus*, and *Sorbus* may be locally common. The species prefers low to medium elevations in large stream valleys. Generally, it occurs low in the larger taluses. Common associates among larger land snails are *Allogona ptychophora ptychophora* and *ptychophora solida, Oreohelix jugalis,* and *Cryptomastix* n. sp. 3. See Frest & Johannes (1995b) for more information.

**Original distribution:** Probably quite widespread in the northern portion of the lower Salmon River valley, roughly from Slate Creek to the river mouth. This species is absent from basalt terrain of similar age, physiography, and history in the lower Clearwater River valley, northern Hells Canyon, and northern Little Salmon River valley.

**Current distribution:** Remains in a few isolated colonies in the most undisturbed parts of its original range, particularly along a short stretch of the lowermost Salmon River and lower parts of two of its larger creek tributaries. The range has been recently surveyed (Frest & Johannes, 1995b) and has been visited repeatedly by malacologists since the 1860s. It is very unlikely that future finds will substantially increase the geographic range or number of viable colonies. Many sites are on public lands (BLM). The original status survey for the Office of Endangered Species recommended Federal listing as Threatened (Solem & Clarke, 1974). Population trends (number of sites, number of individuals) are downward. For site details and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** While this taxon proved more common than Solem (1975) thought, it is confined mostly to basalt talus in a very limited portion of the lower Salmon River corridor; and colonies are widely separated by areas without this taxon. Extinct colonies are also known; range reduction is demonstrable in the field. A strict lower Salmon River and Idaho endemic.

**Specific Idaho sites:** In 1995, there were about 18 live sites : LSR 14, 15, 69, 70, 98, 102, 103, 106, 109, 118-121. 140, 143, 164, 172, 196.

**Threats:** Heavy grazing in much of its range; talus mining in the lower Salmon River valley, which has recently destroyed some old sites; highway construction and maintenance, including US 95 and smaller roads in the vicinity of White Bird. One largely destroyed site was used as a quarry, and the colony persists only as small remnant patches.

**Criteria for inclusion:** Local endemic; occurrence on pubic lands; past and ongoing threats.

**Recommended status:** This taxon, although it was a Federal C2 candidate (USFWS, 1994), has no special status at present. Minimally, it should be considered a Sensitive species by BLM, Forest Service, and other land management agencies. Federal and State (Idaho) listing as Threatened is appropriate, in our opinion, repeated here from Frest & Johannes (1995a, b). Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other collectors have worked this area for over 130 years, including H. Hemphill, H. B. Baker, A. Solem, and M. Walton. It is very unlikely that substantial expansion of whether range or number of live sites will occur from future work.

**References:** Berry (1932); Pilsbry (1939); Solem (1975); Frest & Johannes (1995a, b ); Deixis collections, 1989-1994.

### *Oreohelix waltoni* Solem, 1975
### lava rock mountainsnail

**Type locality:** "Idaho, Idaho Co., more than 1.6 km up John Day Creek from the Salmon River, north of Lucile"; holotype FMNH 182000; paratypes FMNH 98141, 98151, 170711, 170741; NMC 72060; others in DMNH (unnumbered).

**Description:** Solem (1975) provides excellent illustrations and descriptions of both shell and anatomy. This species was overlooked by earlier collectors, largely because of its rarity. Unusual features are the small, flattened shell, broad umbilicus; prominent ribs; and juvenile sculpture. The white color band above the periphery (not mentioned by Solem (*q.v.*) is also distinctive. It is a member of the *Oreohelix idahoensis idahoensis* species group, as defined above.

**Discussion:** Cited as before (Frest & Johannes, 1995 a, b). Some members of the *Oreohelix intersum* species group (*q.v.*) superficially resemble this taxon (notably the Shingle Creek mountainsnail, *Oreohelix* n. sp. 19); but the coarse ribs and juvenile sculpture, together with lesser characters such as its shell color pattern (discussed by Frest & Johannes, 1995b), distinguish this species. The Wet Gulch mountainsnail (*Oreohelix* n. sp. 24) is superficially similar also; but this species is a member of the *haydeni* species group, with weaker radial ribs and equally prominent lirae, as well as a juvenile typical of its species group. For regional comparisons, see **APPENDIX A**, key 1Q.

**Ecology:** This species is a typical xerophile, found in rather dry, open areas in sage scrub vegetation. The common name suggests association with basalts; this is true of the type locality, but other sites are on mixed schist/alluvium. Most commonly associated plants are grasses, *Artemisia*, and *Celtus*; *Sorbus*, *Prunus*, and *Physocarpus* occur locally. This taxon is the dominant at most sites; but co-occurrence with *Oreohelix jugalis* and *Oreohelix* n. sp. 21 (Box Canyon mountainsnail) was noted at one site each. More frequent associates are *Allogona ptychophora ptychophora* and *Cryptomastix harfordiana*.

**Original distribution:** The lava rock mountainsnail may once have been common in the central part of the lower Salmon River, *i.e.*, between Riggins and White Bird, on suitable substrate.

**Current distribution:** This species survives in perhaps four sites in the vicinity of Lucile and John Day Creek. The type locality has been much affected by cattle grazing, and the species is currently very rare and found in only a limited part of the talus. The second colony mentioned by Solem (1975) may be extinct, as we have been unable to find live individuals there in the last 2 tries (last seen live at this site in 1990). At least one locality is on BLM lands. Finds of recently dead material by us and by S. Welty (pers. comm., 1993) in 1990 and 1991 along the White Bird Creek road indicated the possible presence of a colony in this area (alluded to also by Solem, 1975); however, this area was massively modified for grade improvement and for a home site in 1994, and there is now no chance of survival at this site. We searched the relevant portion of the White Bird Creek valley in 1993 and again in 1994 anyway, unsuccessfully. For site details and map, see Frest & Johannes (1995b).

**Idaho distribution and comments:** This taxon was formerly known from only 1 or 2 sites. Even with complete survey, it remains a very limited species in range, with the old sites now extinct. A lower Salmon River and Idaho endemic.

**Specific Idaho sites:** Only 5: LSR 40, 135, 136, 186, 187. Note that extinct sites are known also.

**Threats:** All known sites are impacted by grazing; the Lucile colony may have been extirpated by sheep grazing; the type locality has been heavily grazed by cattle. The other sites are similarly affected. Road construction and maintenance have considerably reduced the site along US 95. Talus mining, especially for basalt gravel, has affected taluses in the immediate vicinity of all sites. Gold mining and prospecting impacts sites in schist lithologies. Population trends (number of sites, number of individuals) are very clearly downward.

**Criteria for inclusion:** Very local endemic; small number of sites; historic site loss and population decline in recent years; occurrence on public lands.

**Recommended status:** In the last such listing, this species is a Federal C2 candidate (USFWS, 1994). It should minimally be considered a Sensitive species by BLM, Forest Service, and other land management agencies. Comprehensive recent surveys of the lower Salmon River drainage for this and other land snail species were conducted by Frest & Johannes (1995b). Many other collectors have worked this area, including H. Hemphill, H.

B. Baker, A. Solem, and M. Walton. Status surveys for *Oreohelix* species were also conducted in this area in 1973-1974 (Solem & Clarke, 1974); listing was recommended at that time (Solem & Clarke, 1974; Solem, 1975). It is very unlikely that later work will greatly expand either the range or number of sites for this species. We strongly recommend Federal and State (Idaho) listing as Endangered, as we did previously (Frest & Johannes, 1995a, b).

**References:** Solem & Clarke (1974); Solem (1974, 1975); Frest & Johannes (1995a, b); Deixis collections, 1990-1994.

### *Pristiloma* (*Priscovitrea?*) *wascoense* (Hemphill, 1911)
### shiny tightcoil

**Type locality:** The type locality is a characteristically vague Hemphill site (Wasco County, Oregon). We have not seen the syntypes (CAS 58828) of this species; most specimens are in the ANSP. The syntypes are, unfortunately, from two very different sites, Salem, Oregon and Wasco County, Oregon (Roth, pers. comm., 1998), which may make recognition of the species difficult.

**Description:** See Pilsbry (1946) for description and illustrations. The comparatively small size, open perforate umbilicus, and possession of about 4-4 1/2 whorls as an adult seem distinctive. The usual adult diameter is about 2 mm. The final whorl is slightly wider than those preceding. Shell very low conoid, with evenly rounded, convex whorls (periphery median). This taxon is similar to *P. chersinella*: but the latter has about 1/2- 1 whorl more; a slightly wider umbilicus; is less depressed; and has evenly spaced whorls to the aperture. The maximum diameter of *P. chersinella* is also greater, generally 3.5- 5.0 mm.

**Discussion:** Previously (Frest & Johannes (1995a) covered under the same name. We have not examined material from all reported sites; but suspect that the species is composite, with west Cascades and east Cascades sites seemingly consistent in morphology. Some Eastside Cascades occurrences are perhaps better assigned to *P. chersinella* or to other, undescribed species. The anatomy is unknown. For comparisons with other similar taxa in its range, consult key 1S (**APPENDIX A**). Pilsbry (1946) thought that the umbilicus was partly covered by the reflected columella lip: but this appears not to be true.

Old names for this taxon include *Tonites* (*Conulus?*) *wascoensis* Hemphill, 1911 and *Pristiloma chersinella wascoense* (Hemphill), Baker, 1930.

**Ecology:** Most reported localities are from Douglas fir and Ponderosa pine forests, at moderate-high elevations. Associates are uncertain, due to lack of recent records. West Cascades sites commonly have such species as *Haplotrema vancouverense, Ancotrema sportella, Vespericola columbiana, Ariolimax columbianus, Euconulus fulvus alaskensis, Punctum randolphi, Columella* sp., and *Pristiloma lansingi.* One low-elevation eastern Washington record is a relatively moist, shaded basalt cliff and talus with *Populus* cover. Associated land snails included *Anguispira kochi occidentalis* and *Cryptomastix mullani olneyae.* Another, high-elevation site had *Pristiloma lansingi, Euconulus fulvus alaskensis, Punctum randolphi, Vertigo columbiana*, and *Discus whitneyi.*

**Original distribution:** This species was reported by Pilsbry (1946) from about 5 sites: Washington, Adams, Boise, and Shoshone counties, Idaho, and Wallowa County, Oregon. Branson (1980) has more recent records from the Washington Cascades (Mount Rainier National Park). The earlier record from the Olympics (Branson, 1977) is doubtful, and the Cascades specimens need to be compared with Wasco County, Oregon material.

**Current distribution:** We have recently collected this species from one site each in western and eastern Washington. The species does not seem to occur in western Montana, according to R. B. Brunson, and has not been reported in recent collections from northeastern Washington, but was found at one or more sites near Cle Elum, Washington (T. Burke). Recently collected material (R. Forsyth) from southern British Columbia was examined in 1996. We have tried a number of sites in Wasco County without finding this taxon. Our Shoshone County and lower Salmon River localities also have not produced this species. Glacier National Park (Montana) and

California Sierras literature reports are best relegated to other taxa. Confusion with *Pristiloma chersinella* is possible, particularly at sites east of the Cascades axis.

**Idaho distribution and comments:** Potentially, this taxon could occur throughout the Washingtonian Province areas of Idaho. However, it appears to be of very limited occurrence, judging from searches in relatively intact terrain, such as portions of the Clearwater River drainage. Note also that our quite intensive lower Salmon River survey did not turn up this taxon. So far, we have not found it in Idaho at any of our higher elevation sites. We also suspect that it will be absent from areas with basic igneous substrate, such as those underlain by Idaho batholith lithologies, such as granite or pegmatite.

**Specific Idaho sites:** At present, no remaining Idaho sites known with certainty, although there is a high probability of survival in the state.

**Threats:** Much of the area within the original range has been logged or is slated for logging. Much of the clear-cut area is heavily grazed afterwards, essentially precluding recolonization.

**Criteria for inclusion:** Local endemic; occurrence on public lands; loss of historic sites and habitat.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Washington, Oregon, Idaho) listing as Threatened is appropriate for the reasons just cited.

**References:** Hemphill (1911); Pilsbry (1946); Frest & Johannes (1995a); Deixis collections, 1990-1995.

### *Pristiloma* (*Pristinopsis*) *idahoense* (Pilsbry, 1902)
### thinlip tightcoil

**Type locality:** Stevens Ranch, Weiser Canyon (Weiser River), Adams County, Idaho. Holotype ANSP 82353.

**Description:** The best summary description and illustration are in Pilsbry (1946); see also Baker (1931). This species has a depressed shell with low conoid spire (higher than in *arcticum* or *lansingi*, however); narrow, slowly expanding whorls (6-6 1/2 in adults 3.2-3.5 mm in diameter). The shell periphery is well above the median; the aperture is very narrowly lunate, thin except for slight expansion at the axial insertion. Shell thin, yellowish corneous, vitreous, glossy; imperforate. As regards shell features, the close coiling, larger size, and yellowish vitreous shell color distinguish this species from the related *Pristiloma lansingi* and *Pristiloma arcticum.* Comparisons between this and related taxa are made in key 1S (**APPENDIX A**).

**Discussion:** We used the same name for this taxon in earlier work (Frest & Johannes, 1995a, b). Despite the rather broad range historically established (Pilsbry, 1946), we regard this taxon as Sensitive, largely due to two factors: the small number of sites reported since Pilsbry (1946) and the apparent absence of this taxon from historic sites.

**Ecology:** A somewhat mesophilic species occurring generally in rather open-largely closed-canopy Ponderosa pine-Douglas fir forests, at rather low elevations, on a variety of substrates. In general, moist valley, ravine, gorge, or talus sites are preferred, *i.e.*, low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture for at least part of the year is a *desideratum.* Land snail associates include species of *Cryptomastix* (especially *mullani mullani*) and *Allogona, Radiodiscus abietum, Microphysula ingersolli*, and some more widespread forms (Baker, 1932). On occasion, this species has been found with such rare taxa as *Megomphix lutarius, Polygyrella polygyrella, Oreohelix haydeni hesperia, Pristiloma subrupicola*, and *Cryptomastix mullani latilabris.*

**Original distribution:** Reported formerly from the following Idaho counties: Adams, Boise, Benewah, Clearwater, Idaho, Kootenai, and Shoshone. Included are sites currently in Payette, Nez Perce, Clearwater, and the Idaho Panhandle National Forests.

**Current distribution:** Uncertain; we have not found this taxon at many of the old sites; nor has Brunson at his western Montana sites. T. Burke (pers. comm., 1994) has not collected this species in northeastern Washington. Recently collected at one site in the lower Salmon River drainage, Idaho County, Idaho (Frest & Johannes, 1995b) and at one site near Cle Elum, Kittitas County, Washington (T. Burke, pers. comm., 1995). S. Welty (pers. comm., 1994) has also repeatedly tried unsuccessfully to recollect this species at some of the old sites, *e.g.,* Rabbit Creek.

**Idaho distribution and comments:** Note that this taxon has the potential to have originally ranged throughout the Washingtonian Province area, judging by recent Washington State finds and past records. This would cover about half of Idaho. However, we seriously doubt its widespread survival.

**Specific Idaho sites:** Only one, LSR 185.

**Threats:** Most of the former range has been logged and is now grazed. Other sites are part of the Coeur d'Alene-Kingston mining district. Some of this area has been severely affected by smelter emissions and mining wastes. Certainly, population trends (in number of sites and number of individuals) are downward.

**Criteria for inclusion:** A regional endemic, reported from a small number of widely scattered sites; few recent successful collections; threats in areas of known past occurrence; occurrence on public lands.

**Recommended status:** This taxon has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho, Washington) listing as Threatened may be appropriate for the reasons cited above. This listing status was suggested by us previously (Frest & Johannes, 1995a, b).

**References:** Pilsbry (1902a, 1946); Baker (1931); Frest & Johannes (1995a, b); Deixis collections, 1990.

### *Vertigo* (*Vertigo*) *idahoensis* Pilsbry, 1934
### Idaho vertigo

**Type locality:** Creek east and northeast of the old town site of Meadows, Little Salmon river drainage, Adams County, Idaho. Holotype ANSP 158670; paratypes ANSP also.

**Description:** The best summary description and illustration are in Pilsbry (1948); see also Pilsbry (1934). This species has an ovate conical shell with high conoid spire; convex, slowly expanding whorls (4-4 1/2 in adults 1.8-2.0 mm in height, 1.2 mm diameter). The aperture is typical for the genus, with slightly expanded peristome; moderately developed sinulus; and four lamellae, all moderately developed: a high-placed columellar; a central, blunt parietal; and two palatals, the second (lower) moderately well immersed and larger than the upper. Shell rimate; minor crest present along palatals; depression from aperture edge across upper palatal. Shell thin, cinnamon brown, apex obtuse; glossy, very weak growth lines and microscopic granulation, vitreous, glossy; imperforate.

Pilsbry (1948) regards this taxon as a member of the *ventricosa* group; but the odd palatals and complete lack of a basal may indicate other affinities. There is a superficial resemblance to members of the *gouldi* and *hubrichti* groups; but the shell color and ornament do not seem to indicate close relationship.

**Discussion:** A distinctive species as *Vertigo* goes. We had originally regarded this taxon as likely a part of the Little Salmon River subcluster, which includes the freshwater *Stagnicola idahoensis* as well as several land snail

species (see Frest & Johannes, 1995) for discussion). However, all of these taxa appear to be restricted to the lower reaches of the Little Salmon, at least presently, and we did not find this taxon in the lower reaches.

**Ecology:** Uncertain. The meadows area comprises grassy meadows at the headwaters of the Little Salmon River. Originally, this region was largely moderate-elevation sedge and grass meadow, with frequent springs and seeps, bogs, and fens. Much of the area has been drained and trenched for agriculture (grazing).

**Original distribution:** Reported formerly from Adams County. Much of the surrounding area, though not the probable type locality itself, is in Payette National Forest. Presumably the Little Salmon River drainage; note headwaters occurrence.

**Current distribution:** Uncertain; we have not found this taxon at the type locality or vicinity; see below for details of other attempts.

**Idaho distribution and comments:** Note that this taxon has the potential to have originally ranged over a substantial portion of central western Idaho, possibly including parts of Washington. We have not found it in the latter State either. We did some searching elsewhere in the Little Salmon River valley, not to mention extensive searches in the lower Salmon drainage generally, without finding this species. We also attempted some collecting in the adjoining Payette River drainage without success.

**Specific Idaho sites:** Only one, the rather vague type locality.

**Threats:** Most of the former type locality area has been heavily grazed. Attempts to locate other populations in the area in 1988, 1993, and 1994 were unsuccessful.

**Criteria for inclusion:** A regional endemic, reported from only a single site; no recent successful collections, despite tries; threats in area of known past occurrence; possible occurrence on public lands.

**Recommended status:** This taxon has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho) listing as Endangered may be appropriate for the reasons cited above.

**References:** Pilsbry (1948).

## SLUGS

### *Hemphillia camelus* Pilsbry & Vanatta, 1897
### pale jumping-slug

**Type locality:** Old Mission (most likely near site of Cataldo Mission, not current Old Mission State Park), Kootenai County, Idaho; holotype ANSP 63926a (by subsequent designation of Baker, 1962).

**Description:** The best description is Pilsbry (1948); but see Pilsbry & Vanatta (1897, 1898) also; and consult key to known species of *Hemphillia*, **APPENDIX A**, key 1G. Specimens ascribed to this taxon need further study. Relatively pale (light tan ground color; weak spotting on mantle; weak mottling on posterior tail) examples with the reported anatomy appear to occur in the Coeur d'Alene and Clearwater drainages, Idaho.

**Discussion:** Specimens that appear similar anatomically from the Salmon River drainage, Idaho, and the central British Columbia Rocky Mountains have darker brown ground color and heavy black mottling over most of the tail,

except for a narrow central dorsal band. Dorsal band light; same color as ground color; on larger specimens with central thin forked black streak.

**Ecology:** This mesophile-notophile slug species is found mostly in relatively intact *Pinus ponderosa-Pseudotsuga menziesii* forest, generally at lower elevations along near major streams. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistent moisture and a rich flora, including a diverse understory and well-developed duff layer, are characteristic. Sites at which we have collected this species had a diverse deciduous understory, rich forb, and nonvascular flora as well, and tended to be closed- nearly closed-canopy forests with large, widely-spaced conifers. Substrate was predominantly basalt; but limestone- and schist-derived soils were noted at some old sites. The accompanying land snail fauna is generally diverse also, and includes such species as *Anguispira nimapuna*, *Anguispira kochi occidentalis*, *Polygyrella polygyrella*, *Cryptomastix mullani* subspp. and other *Cryptomastix* species, *Allogona lombardii*, *Allogona ptychophora ptychophora*, and the slug *Zacoleus idahoensis*.

**Original distribution:** Portions of the upper Coeur d'Alene River drainage, including the lower St. Joe River valley; portions of the upper Clearwater River drainage, including the Selway River valley and South Fork Clearwater River valley; ?part of the lower Salmon River valley: Kootenai, Shoshone, Clearwater, and Idaho counties, Idaho. Historic sites were in Clearwater National Forest; St. Joe National Forest; Nez Perce National Forest; and possibly on Nez Perce Tribe lands.

**Current distribution:** Survives at relatively undisturbed sites in portions of its old range. We have recently collected specimens along the South Fork Clearwater River and Selway River drainages. Slugs of this genus reported from the lower Salmon River area may be another species; but are provisionally retained in this species (Frest & Johannes, 1995a; sites and map). Similar specimens are also known from the central British Columbia Rocky Mountains. We were unable to collect this species at several of the old sites, including the type locality, in 1991 and 1994. R. B. Brunson (pers. comm., 1992) did not find this species in western Montana.

**Idaho distribution and comments:** in the strict sense, likely to occur in much of the Washingtonian Province areas of Idaho, especially the Idaho Panhandle originally. Salmon River occurrences may be another taxon.

**Specific Idaho sites:** LSR sites: 177. Other sites include 1388.

**Threats:** Logging and forest fires in much of the original habitat. This species, like most *Hemphillia*, is relatively Sensitive to disturbance, unlike some other slug genera. Much of the area logged has been grazed; and the species is absent from grazed areas. Highway location along the major river corridors has also substantially reduced habitat, *e.g.*, ID 3, 14, & 50, US 12. Mining, smelting, and wastes from such operations have severely affected portions of the historic range also.

**Criteria for inclusion:** Local endemic; reduced habitat and ongoing threats; loss of historic sites. Population trends (number of sites, number of individuals) are downward.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho) listing as Threatened is appropriate for the reasons just cited.

**References:** Pilsbry (1946); Pilsbry & Vanatta (1897, 1898); Deixis collections, 1991-1997.

### *Magnipelta mycophaga* Pilsbry, 1953
### magnum mantleslug

**Type locality:** Lolo Pass, Clearwater National Forest, Idaho County, Idaho; holotype CAS 32640; other specimens USNM 860557; ANSP; Deixis collection; Burke collection.

**Description:** For best description and illustration see Pilsbry & Brunson (1954); see also Pilsbry (1953) and Webb & Russell (1977). This is a large slug (length to 65-70 mm); mantle length to about 55 mm in large adults; sole color grayish-white; body ground color warm gray; mantle heavily and irregularly spotted with black; black pigment absent over anterior half of body; posterior with small black spots and granules, becoming more dense towards tail and sometimes loosely arranged into oblique transverse lines. Pneumostome small, strongly anterior in position. Slime colorless.

**Discussion:** This monospecific genus does not closely resemble any other described North American slug. The large, spotted mantle covers most of the body, even when preserved. The light body color and conspicuous spotting are also unusual.

**Ecology:** Like various *Hemphillia* species, this taxon prefers moist, cool, and relatively undisturbed forest with a diverse understory and intact duff (litter) layer. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum.* This taxon appears to be mesophilic to slightly notophilic. At the best-known site, this species was associated with *Allogona ptychophora ptychophora* and *Cryptomastix mullani mullani,* in *Picea englemani-Abies lasiocarpus* forest (Pilsbry & Brunson, 1954). At the type locality, the rather open subalpine forest is primarily *Pinus albicaulus* and *Abies lasiocarpus.* Mollusk associates include *Cryptomastix mullani mullani, Zacoleus idahoensis*, and *Udosarx lyrata lyrata.* Elevations at sites range from 4,500-7,500'. Canadian specimens came from slightly lower elevations. Associates there include *Hemphillia camelus* and *Deroceras laeve.*

**Original distribution:** Portions of western Montana (Salish Mountains, Flathead National Forest, Flathead County; Sapphire and Garnet ranges, Lolo National Forest, Missoula County), the Idaho Panhandle (Bitterroot Mountains, Clearwater National Forest, Idaho County), northeastern Washington (Ferry County), and south-central British Columbia. The Washington sites were discovered by T. Burke, Wenatchee National Forest; the British Columbia sites by D. J. Huggard.

**Current distribution:** Survives in limited colonies within the original range. Specimens were recently noted from the Rocky Mountains in central British Columbia.

**Idaho distribution and comments:** According to Frest & Johannes (in press), likely to be confined in Idaho to the Idaho Panhandle portion of the Washingtonian Province. Originally, Idaho sites probably constituted about 1/4 of the historic range. Status of Washington and Montana sites is also presently uncertain.

**Specific Idaho sites:** Formerly (T. Burke, pers. comm., 1998) found in Idaho; but no definite sites have been adduced in recent years. Likely to still survive in mature forest at a few Idaho sites.

**Threats:** Much of the original range has been logged or is slated for logging. Much of the logged terrain is currently being grazed. The slug is absent from all but relatively undisturbed sites. Urban expansion in Missoula area is also of concern.

**Criteria for inclusion:** Local endemic; monospecific genus; past and continued threats to habitat.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Washington, Idaho, Montana) listing as Endangered is appropriate for the reasons just cited. Substantive expansion of the range of this large and distinctive taxon due to future work is unlikely.

**References:** Pilsbry (1953); Pilsbry & Brunson (1954); Webb & Russell (1977); Deixis collections, 1996-1997.

## *Prophysaon humile* Cockerell, 1890
## smoky taildropper

**Type locality:** Location of holotype uncertain; type locality woods around Coeur d'Alene Lake, Kootenai County, Idaho.

**Description:** See Cockerell (1890) and Pilsbry (1948) for best descriptions and illustrations. Also consult key to *Prophysaon* species, **APPENDIX A**, key 1O. Body length to about 24 mm; mantle dark smoke-colored, with strong lateral black bands and darkly mottled central area; posterior with two prominent lateral black bands; head, neck, and general groundcolor light gray; dorsal stripe broad and weak gray, as in *vanattae*, bordered by narrow groundcolor chevron and then by much lateral darker bands. Sole gray; slime colorless.

**Discussion:** This taxon somewhat resembles *vanattae* in possessing a weak darkish broad triangular dorsal stripe and dark lateral posterior bands. The groundcolor is different, however; and this taxon lacks the common orange-red to scarlet coloring on the upper body (especially posterior to mantle) typical of *vanattae*. Ascriptions of *humile* to western Washington (Dall, 1905; Henderson, 1929; Branson, 1977) appear to be in error and apparently date largely to Pilsbry & Vanatta (1898); Pilsbry (1948) expressly refers such slugs to *vanattae*. Even allowing for wide color variation in *vanattae*, we have seen no western Washington or western Oregon slugs referable to this species. There is a possibility of its occurrence, however, in northeastern Washington.

**Ecology:** A strong mesophile-notophile, found mostly in low-medium elevation pine and spruce forests. Sites with perennial moisture and much downed wood are preferable, especially if accompanied by a diverse understory with a strong deciduous and forb component. Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*. Associates include *Hemphillia camelus*, *Allogona ptychophora ptychophora*, *Anguispira kochi occidentalis*, *Cryptomastix mullani mullani* and other *Cryptomastix* spp., *Polygyrella polygyrella*, and *Radiodiscus abietum*. Substrate includes basalt and various igneous lithologies. Most old sites were in river and major stream valleys, at the base of major slopes. Allowing for differences in dominant tree species, habitats for western Cascades and Coast Range *Prophysaon* species are quite similar. See Frest & Johannes (1993c) for discussion.

**Original distribution:** Probably originally very widespread in the Idaho Panhandle, *i.e.* in the Bitterroot Range Benewah, Clearwater, Kootenai, and Shoshone counties, Idaho. This taxon should occur in adjoining portions of Montana and Washington as well, although definite recent records are lacking. Old sites are in Clearwater National Forest and St. Joe National Forest. Sites on the Coeur d'Alene Reservation are possible also.

**Current distribution:** Still survives in Shoshone County (collected 1994); likely to occur in scattered sites within the original range, *e.g.*, Branson, Sisk, & McCoy (1966). We have unsuccessfully tried to recollect some of the old sites (1994).

**Idaho distribution and comments:** Idaho Panhandle portions of the Washingtonian molluscan Province. Note that all definite historic sites were in Idaho, but that most of these were in the Coeur d'Alene-Kellogg corridor, much affected by mining.

**Specific Idaho sites:** Pilsbry (1948) and collection examination indicates about 5 historic sites. Note that literature usage, until description of redescription of *Hemphillia malonei*, sometimes confused the two taxa. Only Idaho Panhandle sites in the counties listed above are likely valid. Recent collections are essentially very few.

**Threats:** Development around Coeur d'Alene Lake is extensive and recent. Mining and smelting operations in the Coeur d'Alene District have been widespread and have had long-term (still ongoing) effects. Roads along the major river corridors within the range (*e.g.*, I-90; Idaho 3; Co. 4, 50) are likely to have been placed in optimum habitat for this species.

**Criteria for inclusion:** Local endemic; loss of habitat; loss of historic sites; ongoing and past habitat modification and threats. The range is unlikely to be significantly expanded by future finds.

**Recommended status:** This species has no special status at present. It should at least be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho) listing as Threatened is appropriate for the reasons just cited, as was recommended by Frest & Johannes (1995a) also.

**References:** Cockerell (1890); Pilsbry (1948); Deixis collections, 1992-1994.

### *Udosarx lyrata lyrata* Webb, 1959
### lyre mantleslug

**Type locality:** "About 2.5 miles down from the crest of Lolo Pass, Clearwater County, Idaho; and about 39 miles from Lolo, Montana" (Webb, 1959); this would be in Clearwater National Forest, about 2 mi. west from US 12 on FR 595. See also Webb (1980). Location of the type is not known; presumably in Webb collection.

**Description:** See Webb (1959, 1980) for description and illustrations. Burch & Pearce (1990) have an illustration purportedly of this taxon, derived from Webb's photo. Body bluish-gray, with tawny dorsal streak; posterior part of body with definite narrow keel; 7-8 posterior longitudinal grooves; mantle with near-marginal lateral blackish stripes forming lyre-shaped pattern confined to ventral third of mantle; dorsal half of mantle with blackish punctuations. Length in excess of 25 mm alive.

**Discussion:** Burch & Pearce (1990) evidently regard *Udosarx* as a synonym of *Zacoleus*. As Webb (1959, 1980) was quite aware of *Zacoleus*, dissected both the latter and *Udosarx*, and explicitly rejects this assignment, we maintain both as he revised them. Burch & Pearce (*op. cit.*) provide no rationale for their action.

**Ecology:** Subalpine, partly open, mixed pine and fir forest with common forbs and fallen wood characterize the type locality. Other sites are as typical for mesophile species: moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture for a significant part of the year is a *desideratum*. Associated larger mollusks in the Lolo Pass area include *Polygyrella polygyrella*, *Hemphillia danielsi*, *Cryptomastix mullani mullani*, *Radiodiscus abietum*, *Microphysula ingersolli*, *Oreohelix subrudis*, *Anguispira kochi occidentalis*, and *Euconulus fulvus alaskensis*.

**Original distribution:** Scattered sites in the Bitterroot Mountains and upper Clearwater River and Clark Fork drainages, Clearwater National Forest, Idaho and Clearwater counties, Idaho and Lolo National Forest, Missoula County, Montana.

**Current distribution:** Known to survive in scattered sites in the original range. We collected one Idaho County, Idaho site in 1993.

**Idaho distribution and comments:** This is another Washingtonian Province taxon, most likely to be found in Idaho in the Panhandle counties. Judging by historic sites( several quite vague), Idaho probably constituted half or more of the total range.

**Specific Idaho sites:** Lolo Pass area.

**Threats:** Much of the region has been or is slated for logging; much is currently being grazed; and the species seems to be absent from heavily modified areas. Major forest fires within the upper Clearwater (Lochsa and Selway drainages), both in 1910 and more recently, have considerably reduced the potential range also.

**Criteria for inclusion:** Local endemic; occurrence on public lands; monospecific genus.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho, Montana) listing as Threatened may be appropriate for the reasons just cited.

**References:** Webb (1959); Webb (1980); Deixis collections, 1993.

**Freshwater Snails**

***Acroloxus coloradensis* (Henderson, 1930)**
**Rocky Mountain capshell**

**Type locality:** Petersen Lake, near Nederland, Colorado (original designation by Walker, 1925, as *Ancylus henderson*i): holotype UMMZ

**Description:** Shell roughly 3-5 mm in length; about 1.5-2.0 mm wide; elliptical, thin, low (1.0-1.2 m high; with distinctive sharply pointed apex, directed to the left (as seen from above) and often located posterior to the shell center. Color of periostracum brown to greenish; often thin; shell often thin.

**Discussion**: This is the sole native North American member of a widespread primitive Northern Hemisphere superfamily with about half a dozen widespread and endemic taxa in Europe and Asia (the European *Acroloxus lacustris* may have been introduced into eastern Canada: Clarke & Hovingh, 1993).

**Ecology:** So far known mostly from small to medium sized oligotrophic lakes, generally with no to limited macrophytes and stony substrate, also generally at high to medium elevations. At least some sites occur in areas with calcareous regolith; but not all. For detailed ecological information, see Clarke & Hovingh, 1993.

**Original distribution:** May have been widespread in the medium to high elevations of the Rocky Mountains. No Cascades sites are known, although it could well have been present there. Lack in this range would create a more substantial disjunction from eastern Russian Federation sites.

**Current distribution:** Small number of sites in western Montana, western Colorado, Alberta, and British Columbia (Rocky Mountains).

**Idaho distribution and comments:** Idaho has sufficient high mountains with oligotrophic lakes, particularly in the Panhandle and eastern side of the State; but also in the center, as to make detailed searches for this taxon worthwhile. Note that sites are known in Rocky Mountain Colorado, Montana, Alberta, and British Columbia.

**Specific Idaho sites**: None are known at present, although suitable habitat does exist in the State; and known sites could accommodate Idaho in the same trend.

**Threats:** Ski lodges and resorts; similar developments on or near medium to high elevation mountain lakes; mining; fish stocking and faunal manipulation.

**Criteria for inclusion:** Local endemic; occurrence on public lands; ongoing major threats; very substantial reduction in habitat. Habitat and range for this taxon may be expanded by future work; but will remain limited.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Colorado, Montana) listing as Endangered is appropriate; as would be Idaho listing if the taxon is found there. No recommendation for Idaho populations (if any) can be made at present; but the species is likely quite rare in the state.

**References:** Walker (1925); Henderson (1930); Clarke (1970, 1973, 1981); Paul & Clifford (1991); Clarke & Hovingh (1993).

## *Amnicola* n. sp. 1
## Washington duskysnail

**Type locality:** Will be designated at time of formal description.

**Description:** Shell similar to that of *Amnicola limosa* (see Hershler & Thompson, 1988); height to 5.0 mm; ovate-conic, well-rounded whorls; comparatively thin; 4-5 whorls in adult; small umbilicus. Body similar to *Amnicola limosa*, but dark pigment on mantle concentrated in bar parallel to edge of pallial cavity, then in dark streak along intestine and digestive gland; no bar on outside cephalic tentacles, although a faint central band is sometimes present.

**Discussion:** This taxon is illustrated as *Amnicola limosa* in Taylor & Bright (1987): see also key 2H, **APPENDIX A**. Confusion with the eastern US *A. limosa* has been clarified by the recent revision of this taxon by Hershler & Thompson (1988). We do not recommend attempts to identify western *Amnicola* species from shells only, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a complete description here. Consultation with a specialist is *de rigueur* for this genus.

**Ecology:** Found in kettle lakes among aquatic macrophyte beds, generally on soft but well-oxygenated substrate, *e.g., Chara* marl. Absent from areas with dense macrophytes or with anoxic sediments. Depth generally 2-6'+. This species grazes periphyton, apparently from macrophyte surfaces, but is also a detritivore. It is apparently solely a limnophile, unlike *Amnicola limosa*, which commonly occurs in streams as well.

**Original distribution:** Probably once common in kettle lakes east of the Cascades crest and west of the Mississippi drainage, in a narrow band in northern Washington, the Idaho Panhandle, and northwestern Montana.

**Current distribution:** Known currently from three sites, two in northern Washington and one in northwestern Montana.

**Idaho distribution and comments:** This is a Washingtonian Province endemic, likely including the upper part of the Idaho Panhandle in its range.

**Specific Idaho sites:** No sites are known; but Montana and Washington occurrence along the Wisconsinan glacial border suggests possible occurrence in Idaho, albeit rarely.

**Threats:** This limnocole species is not found in strongly eutropified kettle lakes, nor in streams. Lakes used as part of irrigation systems, with untreated sewage, or having other sources of nutrient enrichment, typically lack the species. Many of the kettle lakes in the area of occurrence have heavily developed shorelines, including housing with inadequate provisions for sewage and runoff management. Siltation and seasonal anoxia or hypoxia in many of these formerly cobble-bottom oligotrophic environments is also a problem, exacerbated by logging, grazing, and residential development. Lakes that have had extensive treatment to kill out aquatic macrophytes or exotic or "undesirable" fish; to stock game fish; or to modify the native fish fauna also seem to lack this species. The great majority of northern Washington, Idaho, and northwestern Montana kettle lakes have been affected by one or several of such problems. The species is definitely declining in terms of populations and number of individuals.

**Criteria for inclusion:** Local endemic; occurrence on public lands; ongoing major threats; very substantial reduction in habitat. Habitat and range for this taxon are unlikely to be substantially expanded by future work.

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (Washington, Montana) listing as Endangered is appropriate. No recommendation for Idaho populations (if any) can be made at present.

**References:** Deixis collections, 1988-1993.

### *Fisherola nuttalli* (Haldeman, 1843)
### shortface lanx

**Type locality**: "Lower Columbia River" near the old mouth of the Willamette River near Portland, Multnomah County, Oregon (could have been from the Willamette River itself also); Holotype of *Ancylus crassus=Fisherola nuttalli* ANSP 124320; paratype of *Ancylus crassus* ANSP 350079 (both said to be from Spokane River, Washington); other Nuttall specimens USNM 169958, from the Willamette River near Portland, Oregon.

**Description:** The best description and illustrations are those of Frest & Johannes (in press); see also Burch (1989, fig. 632). This is a large, often cinnamon-red freshwater limpet, commonly elliptical in outline, longer and wider than high, with anterior-subcentral apex on the midline. The columellar muscle scar is interrupted on the right side. Adult size varies considerably in different-sized streams; but is generally around 10-11 mm. None have been seen with white spot or lines, as in some *Lanx* species.

**Discussion:** For comparisons with related taxa, see key 2F (**APPENDIX A**). This taxon seems to lack the white pigment blotches and spots found frequently in *L. patelloides* and sometimes in *L. alta* as well. The only other lancid with an interrupted muscle scar is *Lanx* n. sp. 1; but the latter is considerably smaller (generally under 5 mm); very deep cinnamon red; about as high as long and higher than wide; and the apex is central. The Banbury lanx is also confined to large limnocrenes or spring outflows; while *Fisherola* occurs only in streams. Note that Burch (1989) and others recognized three subspecies in this taxon: the nominate form, *F. nuttalli lancides* Hannibal, 1912, and *F. nuttalli kootaniensis* (Baird, 1863). With increasing knowledge of the occurrence and distribution (see Neitzel & Frest (1989, 1992, 1993), and Frest & Johannes (1991a, b; 1993c) for details), it is evident that Taylor (*e.g.*, 1985) was correct in recognizing only one form.

**Ecology:** Generally found in unpolluted swift-flowing, highly oxygenated cold water on stable boulder-gravel substrate, often in the vicinity of rapids, in small to large rivers. Macrophytes are generally rare to absent at sites with this species, as is epiphytic algae. This species sometimes occurs with *Fluminicola columbiana*. For details, see Frest & Johannes (in press).

**Original distribution**: Formerly widespread in the lower Columbia River, Snake River, and a few major tributaries, Washington-Oregon-Idaho-Montana-British Columbia. For details, see Frest & Johannes (in press). Most of the old sites are known to be extirpated, *e.g.*, Frest & Johannes (1993g); Neitzel & Frest, 1989, 1993).

**Current distribution**: There is only one known Montana site; and the British Columbia populations appear to have been extirpated. The lower Columbia River populations are largely extinct due to habitat modification caused by Bonneville Power Administration [BPA] dams and impoundments, although one occurrence is known near Bonneville Dam (from National Marine Fisheries Service collections, 1990): still survives in the Hanford Reach, Washington; the lower Deschutes River and the John Day River, Oregon; part of the Snake River (middle Snake, Idaho; Hells Canyon, Oregon-Idaho); the Salmon River, Idaho, and the Methow and Okanogan rivers, Washington; see Neitzel & Frest (1989, 1992, 1993), and Frest & Johannes (1991a, b; 1993c) for details. Many of these areas

are on (or influenced by management practices on) federal lands, *e.g.,* Hanford Site (DOE), Deschutes Wild and Scenic River, Hells Canyon National Recreation Area; Okanogan National Forest; Gifford Pinchot National Forest; Mount Hood National Forest; and Bonneville Power Administration.

**Idaho distribution and comments:** Se above. Lower Salmon River sites, rather scattered, extend from the west portion of the River of No Return to its mouth. Hells Canyon sites are in the central and northern portions of the Canyon only. Middle Snake River sites need to be reexamined because of relatively recent landslides and continued water quality degradation. The species originally ranged as far as American Falls in the Snake River. It is absent from many Snake tributaries, including the Clearwater and Boise. Historic sites in the Spokane and Coeur d'Alene systems are accurate; but so far all recent attempts to recollect these drainages have been unsuccessful.

**Specific Idaho sites:** A few are: 505, 1134, 1142.

**Threats:** Impoundment and damming of much of the original habitat; sedimentation; orchard runoff; nutrient enrichment due to agricultural practices; pulp mill effluents; metal smelting residues and discharges; declining water quality through most of the known range.

**Criteria for inclusion:** Riparian associate; current federal candidate; occurs on public lands.

**Recommended status**: This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. NPS (1994) seems barely aware of this taxon. Recommended as Federally Threatened; Threatened in Washington; Threatened in Oregon; Endangered in Montana; and Endangered in Idaho. Note extensive recent surveys specifically for this taxon. Currently a Category 3 Federal candidate (USFWS, 1994). Recommended for listing by Frest & Johannes (1993c). USFWS (1994b) recently rejected a petition to upgrade the status of this species.

**References**: Taylor (1982a); Neitzel & Frest (1989, 1990, 1992, 1993); USFWS (1991, 1994); Frest & Johannes (1991a, b; 1993b, c); Deixis collections, 1987-1994.

### *Fluminicola fuscus* (Haldeman, 1841)
### Columbia pebblesnail

**Type locality**: Type not located; type locality "Oregon"; claimed (Baker, 1964) holotype and paratypes (ANSP 27772, 27774) may not be (see Hershler & Frest (1996); lectotype and paralectotypes of *Amnicola hindsi* Baird, 1863, type locality "River Kootanie" [*sic*: Kootenay River, British Columbia], BMNH 1863.2.4.17A, 1863.2.4.17, subsequently designated by Hershler & Frest (1996); lectotype of *Fluminicola columbiana* Hemphill in Pilsbry, 1899 ANSP 27767; type locality Columbia River, probably at Wallula, Walla Walla County, Washington.

**Description:** See Hershler & Frest (1996) for shell and anatomy. Distinctive features of this taxon are the relatively large size; channeled suture; and reddish-black color, not only of the periostracum but also of portions of the shell, excluding the aperture. This species until very recently was confused with several other taxa, and most commonly is cited as *Fluminicola columbiana* Hemphill in Pilsbry, 1899. *Fluminicola nuttalliana columbiana* Keep, 1891, *Fluminicola columbiana* (Pilsbry, 1899), and *Fluminicola hindsi* (Baird, 1863) have been demonstrated to be synonyms (Hershler & Frest, 1996). Cited as *Fluminicola columbiana* Hemphill in Pilsbry, 1899 in Frest & Johannes (1993c).

This is a large and difficult genus (or soon will be), and we do not recommend identification of material from areas in which similar species are known or likely to occur from shells alone. Consultation with a specialist is especially important for this genus. Note that Hershler & Frest (1996) and we herein (above) regard the genus as paraphyletic. We distinguish two major groupings, basically large (> 5 mm height) and small (< 5 mm height). Within each of these groups, others can be distinguished. First in the larger would be *F. virens* and related species, with a large, triangular penis with terminal papilla; white or clear shell; and anatomical features as in Hershler & Frest (1996); a second large lineage involves species with colored shell; often with black body and visceral coil; and

stout penis lacking a terminal papilla and with proximal half with folds and distal smooth (*F. fuscus*, *F. coloradensis*); third, those with white shell, black animal and visceral coil, and broadly sickle-shaped penis lacking a terminal papilla (*e.g.*, *F. seminalis*); and, fourth, those with the penis broadly alate on the left side (undescribed taxa). Most of the small taxa have a narrow, sickle-shaped penis, white shell, and variably colored animal (but usually not black) and visceral coil. However, until the status of the type species can be determined and more complete revision is undertaken, retention of the name is useful for this group of western North American lithoglyphinid hydrobiids (all but those assigned to *Pristinicola* and *Taylorconcha*: Hershler *et al.*, 1994).

**Discussion:** Coan (1985) and Coan & Roth (1987) ascribe the species to Keep (1887) as *Fluminicola nuttalliana columbiana* Keep, 1887, unlike essentially all other authors. They may be technically correct (ICZN, 1985, Articles 10-12, 50), for even though the name is first mentioned in Hemphill (1881), it was there unaccompanied by a description, definition, or indication; and a short description is supplied in Keep (1887). However, the situation for this and other Hemphill and Carpenter species described under similar circumstances may not be so straightforward.

*Contra* Coan & Roth (1987, p. 327), there is no compelling reason to believe that *Fluminicola nuttalliana columbiana* Keep, 1887 is the same as *Fluminicola columbiana* Hemphill in Pilsbry, 1899 [more properly, *Fluminicola columbiana* Pilsbry, 1899, according to ICZN (1985) rules, if it is assumed that the description in Pilsbry (1899) was written by Pilsbry and not derived from communications with Hemphill; in the latter case, the traditional usage would be correct], even if both were derived from Hemphill lots. According to Coan & Roth (1987, p. 322) Hemphill "lumped together under a single locality specimens from numerous stations". If this is so, the only way to be even reasonably certain that the specimens in Keep's collection were the same taxon as other Hemphill specimens ascribed by Hemphill to the same taxon, let alone from the same locality, would be by direct comparison. Moreover, the types for the 1887 names would have to be drawn from the material in Keep's possession, *e.g.*, "if, on the other hand, a name was made available by "Pilsbry, ex Hemphill MS", or the like, then the converse is the case: supposed Hemphill syntypes have no standing: the type material is only that which Pilsbry (or some other author) consulted" (Coan & Roth, 1987, p. 324). We agree that this follows from Coan & Roth's assumptions; but in this case, much of the type material accepted by Coan & Roth (1987) is incongruent with their choice of author and date for the involved taxa. As far as we can determine, no Keep types for these taxa were originally designated; nor are Keep type lots, from which valid subsequent designations could be made, known to exist (Coan, 1985); this is not surprising, as Keep was not a taxonomist and clearly did not regard himself as such. It is also quite possible that the description used by Keep (1887) derives from Hemphill; in which case the only real addition by Keep is publication. Under such circumstances, the name would be validated; but as Hemphill in Keep, 1887. Further, the descriptions in Keep (1887) are very brief, so much so as to be only dubiously adequate. Again, Keep's intent should be borne in mind; it was not to provide a scientifically credible description. If the descriptions are inadequate, as sometimes stated by Coan (1985), then the Keep names should at best be considered *nomina dubia*, or at worst unrecognizable.

It is also questionable that Keep can be considered "alone responsible both for the name and for satisfying the criteria of availability other than publication" (ICZN, 1985, p. 91 [Article 50 (a)]). Keep himself ascribes the names to other authors; and the sources of these names, which include Hemphill (1881), Hemphill labels, Carpenter labels, and a Carpenter ms. [and may well also have included personal correspondence], are known. The same consideration also applies to Pilsbry (1899) in regard to *Fluminicola columbiana* Hemphill in Pilsbry, 1899. If it may equally be doubted that the ascribed authors, rather than the authors responsible for publication, in these cases satisfy the requirements for availability, this does not particularly enhance the case for ascription to the publication authors, but rather that for considering the names dubious, unavailable at that point, or unrecognizable.

Keep was essentially a popularizer, not a taxonomist, as his whole published corpus makes clear (Coan, 1985). It is evident that he did not intend to formally describe as new *Fluminicola columbiana* or any of the other taxa in Keep (1887) whose names are ascribed to him by Coan (1985). The work involved is very obviously intended as a popular-level treatment of already-named taxa. Keep himself ascribed these taxa to other authors; and later workers, almost without exception, did so likewise [note, *e.g.*, that Burch, 1982 assigned *Fluminicola columbiana* to Hemphill, not Keep as asserted by Coan (1985); this is consistent with Burch & Tottenham, 1980 and Burch, 1989]. We think that, in the meaning of Article 50, it is clear that responsibility for the Keep (1887) names themselves, other than publication, is due to other authors; hence the species are properly ascribed to these authors, not to Keep. Under these circumstances, it is perhaps better either to 1) retain traditional usage

and consider the Keep name for each as a *nomen nudum*, *nomen dubium* or *species inquirenda*; or alternatively 2) to ascribe the names to the original authors as "------ in Keep, 1887". If conservation of the "-------- in Keep, 1887" name is desirable, then consideration of either 1) designation of a neotype from material labeled as type material by the species author [not Keep] or reasonably believed to be such; or 2) restriction of the 1887 name to the [missing or nonexistent] Keep types, *e.g.*, as done by Paul (1971) for missing cystoid holotypes may be preferable.

In short, we argue that the names in question originate with Hemphill or Carpenter; Keep's specimens came from Hemphill or Carpenter; Keep was not a taxonomist; Keep (1887) is not a taxonomic work but a popular work listing what Keep evidently thought were described species; and Keep himself ascribed the species to Hemphill or Carpenter. The first descriptions of these taxa, which occur in Keep (1887), are so brief as to make it difficult to recognize the species involved, and their authorship is not clear. If the descriptions are inadequate, then Keep's use of the names at best creates a *nomen dubium*, and traditional usage is correct. The critical question, if the descriptions are accepted as adequate, is their source. If they derive from Hemphill or Carpenter (*e.g.*, letters or mss., such as the one later published as Hemphill (1890a)), then publication is the only contribution of Keep to the names; and they should therefore be credited to Hemphill or Carpenter in the format "_____ in Keep, 1887" under the provisions of Article 50 (ICZN, 1985). We regard the descriptions in Keep (1887) as inadequate and clearly not intended to describe new taxa but merely to differentiate them from other described taxa; and would prefer not to recognize the names as validated in the 1887 publication. Much of the justification for the few former usages of Keep names, *e.g.*, Palmer (1958); Ponder (1985); and Coan (1985), in our view derives from usage of the earlier version of the Code (ICZN, 1964), in which the wording of Article 50 is somewhat different.

**Ecology**: Restricted to small-large rivers, in swift current on stable gravel to boulder substrate in cold, unpolluted, highly oxygenated water, generally in areas with few aquatic macrophytes or epiphytic algae. Sometimes co-occurs with *Fisherola nuttalli*. For detailed discussion, see Frest & Johannes (in press).

**Original distribution**: Lower Columbia River and a few of its major tributaries in Washington, Oregon, Idaho, and British Columbia (and probably Montana as well). For details, see Frest & Johannes (in press). The record in Branson, Sisk, & McCoy (1966) is erroneous.

**Current distribution**: Possibly extinct in the lower Columbia River, Washington-Oregon, and definitely extinct in most of the middle and upper Columbia River, Washington, Montana, and British Columbia; and in the Payette River, Idaho; still survives in the Okanogan and Methow rivers, Washington; the Hanford Reach, Washington; and a limited portion of the Snake River and possibly a few of its tributaries (Frest & Johannes, in press). Many of the remaining sites are on, or influenced by management practices on, federal lands, *e.g.*, Hanford Site (DOE), Hells Canyon National Recreation Area; Okanogan National Forest; Gifford Pinchot National Forest; Mount Hood National Forest; and Bonneville Power Administration. Lower Columbia River rocky and free-flowing lotic habitat largely has been eliminated by BPA dams and impoundments; siltation in this area has also been affected by agricultural practices and by clear-cutting on adjacent National Forests.

**Idaho distribution and comments:** At this point, this taxon is known with certainty in Idaho largely from the Hells Canyon part of the Snake and from the lower Salmon River, although occurrence in the middle Snake (very rarely) appears possible.

**Specific Idaho sites:** See Hershler & Frest (1996) for presently accepted Idaho sites. Note that such common "taxa' as *F. hindsi* and *F. columbiana* are now thought to be synonyms; but that most records for these taxa are also thought to refer instead to additional undescribed species. Hershler and I are currently seeking funding to revise Idaho, Wyoming, and Utah *Fluminicola*. Payette sites appear to have been extirpated.

**Threats:** Impoundment and damming of much of the original habitat; sedimentation; orchard runoff; nutrient enrichment due to agricultural practices; pulp mill effluents; metal smelting residues and discharges.

**Criteria for inclusion:** Current federal candidate; occurrence on public lands; riparian associate.

**Recommended status**: Currently a Federal Category 2 candidate (USFWS, 1994a). At present has no special or protected status; minimally, this species should be considered Sensitive by Forest Service, BLM, and other appropriate land management and wildlife personnel. It should be considered Endangered Federally and in Washington, Oregon, and Idaho (Frest & Johannes, in press). No recommendation is possible for Montana at this time. Note extensive recent surveys specifically for this taxon. Recommended for listing by Frest & Johannes (1993a). USFWS (1994b) recently rejected a petition to upgrade the status of this species.

**References**: Pilsbry (1899a); Taylor (1982b); Neitzel & Frest (1989, 1990, 1992, 1993); USFWS (1991, 1994); Frest & Johannes (1993c); Hershler & Frest, 1996.

### *Fluminicola minutissimus* Pilsbry, 1907
### pixie pebblesnail

**Type locality:** Price Valley, Weiser River drainage, Washington [now Adams] County, Idaho; lectotype ANSP 94273. See Hershler & Frest (1996) for discussion of possible location of this site.

**Description:** Best description is by Hershler & Frest (1996). Distinctive features include the small, almost globose, thick shell (height only 1.5 mm); blunt spire; and nearly circular aperture. The anatomy remains unknown. *Fluminicola* is a large and difficult genus (or soon will be), and we do not recommend identification of material from areas in which similar species are known or likely to occur from shells alone. Consultation with a specialist is especially important for this genus.

**Discussion:** As noted under earlier discussion of the genus, this occurrence of small *Fluminicola* (*s.l.*) is somewhat disjunct from better-known regions, which tend to be on the northwest and western periphery of the Great Basin and in drainages immediately north or west of the Great Basin. There is a very slight chance that this is in actuality a species of *Pyrgulopsis*; but known morphology is more consistent with that of other small, *Somatogyrus*-like *Fluminicola* species. Probable extinction of this form may permanently preclude full elucidation.

**Ecology:** Unknown. Appears to be a spring-dwelling taxon. Price Valley is in the headwaters of the Weiser River drainage, at moderate elevation. Much of the area is *Pinus ponderosa* forest, often with more recent Douglas fir plantings.

**Original distribution:** Known only from the type locality, mostly in Payette National Forest.

**Current distribution:** Has not been recollected in recent years, despite several attempts (Hershler & Frest, 1996). The taxon could be extinct; but comprehensive survey of the upper Weiser drainage has not been undertaken as yet. Some surrounding areas, *e.g.*, parts of eastern Oregon, Hells Canyon, and much of southern Idaho, have recently been surveyed in some detail for spring snails; but this taxon has not turned up, either at our sites or those of Hershler and his collaborators.

**Idaho distribution and comments:** Essentially a lost taxon, in that the original site was rather vague and attempts recently to relocate it have failed. Undoubtedly a valid taxon, but only likely *Fluminicola* (could be *Pyrgulopsis*) and possibly extinct. A valid Idaho endemic. If a *Fluminicola*, this would be a very isolated site and by far the eastward-most site for the species group (which represents three or more undescribed generic-level taxa). Hence the taxon is of considerable biogeographic interest.

**Specific Idaho sites:** one site, the type locality, said to be in the Weiser River drainage (see above).

**Threats:** Much of the potential area of occurrence has been heavily grazed and logged, both of which activities continue. Springs in Price Valley have recently been diverted and capped for water supply. A large lumber mill is located near the mouth of Price Valley.

**Criteria for inclusion:** Local endemic; probable occurrence on public lands; ongoing and past threats to area of potential occurrence; apparent loss of historic site (type locality).

**Recommended status:** This species has no special status at present. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (Idaho) listing as Endangered is appropriate for the reasons just cited above; recent surveys have been conducted, unsuccessfully (Hershler & Frest (1996). There is sufficient recently-collected information, and recent survey work, to indicate that listing is justified.

**References:** Pilsbry (1907); Hershler & Frest (1996).

### *Lanx* n. sp. 1
### Banbury Springs lanx

**Type locality:** To be designated when species is described.

**Description:** See USFWS (1992d) for best short description. The small (generally < 5 mm length), very high, evenly cinnamon red shell, with almost central (displaced slightly posteriorly) sharp apex on the midline and height often exceeding width and approaching length, is unique.

**Discussion:** This taxon is retained in *Lanx* even though the muscle scar is interrupted on the right side, as in *Fisherola*, largely due to the near-central, slightly posteriorly displaced apex position. For discussion see Frest & Johannes (1993d).

**Ecology:** Occurs on cobbles and boulders in relatively swift current in large, cold, and clear, very large springs and spring runs. Typically, epiphytic algae and aquatic macrophytes (*Veronica*, *Rorippa*) are rare in areas with this species. For details, see Frest & Johannes (1992a) and USFWS (1992d). A crenocole, lithophile, and perilithon grazer, found generally on sides or undersides of pebble to boulder-sized rocks.

**Original distribution:** Possibly once much more common in the large spring complexes in the middle Snake River drainage, central southern Idaho.

**Current distribution:** Known from only four populations in limited areas in four large nasmodes, Snake River drainage, Gooding County, Idaho. At least two sites also have the listing candidate Shoshone sculpin.

**Idaho distribution and comments:** See above. The four sites are well-known to USFWS. The Box Canyon site needs to be revisited, because of severe pollution incidents in recent years.

**Specific Idaho sites:** See above. A middle Snake River and Idaho endemic.

**Threats:** The middle Snake River, the Snake groundwater aquifer, and the surface springs are becoming nutrient-enriched due to agricultural and piscicultural discharges. Diversion and capping of springs for power generation, fish farms, human water supply, stock use, and other reasons is pervasive, with most spring complexes affected, including the three with this species. In these, the species is now confined to relatively tiny areas in large complexes. Rather extensive recent surveys in the middle Snake drainage (referenced in USFWS, 1993 and herein under Frest & Johannes, in part) make it very unlikely that major augmentation of either geographic range or site numbers will occur from future research. We have recently (1991-1996) surveyed over 500 sites in southeastern Idaho without finding this taxon, confirming its restriction to part of the Middle Snake River's tributary drainages.

The last-found population was located originally in 1994 and confirmed in 1997. One of the best populations has recently (1997) been threatened because of illegal dumping of large amounts of fish manure into a relatively pristine, BLM-owned nasmode. Its current status is uncertain.

**Criteria for inclusion:** Very local endemic; past and ongoing threats; documented loss of most of possible historic range.

**Recommended status:** Currently listed as Endangered (USFWS, 1990, 1992d). Should be listed similarly in Idaho, and regarded as a Sensitive species by appropriate federal (*e.g.*, BLM) and state wildlife and land management agencies. Listing of this species is currently being contested in court.

**References:** Taylor (1985a); Frest & Johannes(1992a); USFWS (1992d); Deixis collections, 1988-1992.

### *Lyogyrus* n. sp. 2
### masked duskysnail

**Type locality**: None as yet; undescribed taxon.

**Description:** Very high-spired, tall, with evenly convex whorls and round, unreinforced aperture margin, with up to 8 whorls as an adult. Large for genus; to 3 mm length. Mantle light in color; cephalic tentacles light, with single distinct central yellow bands on upper surfaces when live; "mask" of black pigment on neck and around and between eyes. Shell semi-transparent, off-white or light tan; umbilicus very small (perforate), open. Operculum near circular, colorless peripherally, darker (orange) at subcentral nucleus; paucispiral.

We do not recommend attempts to identify western *Lyogyrus* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a complete description here. Consultation with a specialist is *de rigueur* for this genus.

**Discussion:** The shell shape and pigment pattern are distinctive as compared to previously described forms. This species more closely resembles eastern US species than do most of the recently discovered western novelties. This taxon was cited as *Lyogyrus* n. sp. 2 in Frest & Johannes (1993c): see Table 5. For comparisons with other amnicolinid taxa, see key 2H (**APPENDIX A**). Note that Hershler (1999) erects another genus for *Lyogyrus greggi*; of all the western forms known to date, this one is most variant and more closely resembles eastern forms, even though it, too has a paucispiral operculum.

**Ecology**: Kettle lakes on the periphery of the Columbia drainage in northern and central Washington, in areas heavily affected by Late Pleistocene glaciation. This limnophile species occurs on oxygenated mud substrates in areas with some aquatic macrophytes (*Potamogeton crispus*, *Elodea*, *Myriophyllum spicatum*, *Ceratophyllum densum*, *Chara*). Sizable numbers of waterlogged deciduous leaves (*Alnus*, *Populus*) are always present. Occurs with another rare endemic (outside the range of the Northern Spotted Owl), *Amnicola* n. sp. 1 at one site. This pelophile species appears to graze periphyton from leaf and other plant fragment surfaces; but may partly be a detritivore as well.

**Original distribution**: Probably quite common at one point in northern and central Washington on the east side of the Cascades east to the Rocky Mountains, in heavily placated valleys, in Pend d'Oreille, Stevens, Ferry, Okanogan, and Chelan counties, Washington. This taxon could also be found in adjacent parts of the Idaho Panhandle and northwestern Montana with similar geologic history.

**Current distribution**: Known from two large kettle lakes, one in Ferry County and the other in Wenatchee National Forest, Chelan County, Washington.

**Idaho distribution and comments:** Ultimately, this taxon may be found to have a distribution similar to that of the Washington duskysnail, *Amnicola* n. sp. 1, and hence would include the northern portions of the Idaho Panhandle, with potentially about one-quarter of the full range.

**Specific Idaho sites:** So far, no specific Idaho sites; needs a systematic search.

**Threats:** Most large kettle lakes in northern Washington and Idaho and northwestern Montana have either been heavily poisoned and stocked; serve as preferred sites for human habitation; or have been included in irrigation systems, with resultant eutropification and extirpation or reduction of the native mollusk fauna. Many such lakes now lack mollusk faunas or have very reduced, low-diversity, generalized faunas, even though dead shells of other taxa may be common in lake sediments just under the surface. Eutropification problems have resulted in citizen complaints and initiation of cleanup programs in both areas with this species.

**Criteria for inclusion:** Local endemic; occurrence on public lands; riparian associate.

**Recommended status**: This taxon is a ROD (1994) Survey and Manage species. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies; it should also be designated a ROD Riparian Reserve species. We have previously (Frest & Johannes (1993c) recommended listing of this taxon. On present evidence, should be listed as Endangered both federally and in Washington. Clarke (1976b) surveyed a number of Washington kettle lakes while finding only one site; earlier workers (*e.g.*, Henderson, 1929a, 1936b) had examined many more without finding this taxon. We have recently (1993 to date) begun surveying additional kettle lakes in Washington, Montana, and Idaho, with very limited success so far.

**References**: Clarke (1976b); Frest & Johannes (1993c, 1999); Deixis collections, 1988-1993, 1996.

### *Lyogyrus* n. sp. 6
### Snake duskysnail

**Type locality:** Will be designated when the species is formally described.

**Description:** A small form (height generally less than 2 mm) with strongly convex whorls (4.5-6.5); light visceral coil and pallial roof; only scattered melanin granules on the body; and strongly pigmented penial filament; spire comparatively high conical; umbilicus perforate.

**Discussion:** The taxon is compared with the other presently known western US forms in key 2H (**APPENDIX A**). We do not recommend attempts to identify western *Lyogyrus* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a complete description here. Consultation with a specialist is *de rigueur* for this genus. Note that Hershler (1999) erects another genus, *Colligyrus*, for *Lyogyrus greggi* and a new taxon. This form may also belong to the same genus.

**Ecology:** Occurs in small cold springs and seeps, generally at low elevations, on gravel to cobble substrate, usually basalt. Macrophytes (generally patchy *Rorippa* only) and epiphytic algae are rare; depth is usually under 2"; much woody debris may be present. This taxon appears to be photophobic; and is a perilithon and periphyton grazer. Very few other mollusks are found in this microhabitat.

**Original distribution:** Probably common in the upper Snake River and Bear River drainages, southeastern Idaho.

**Current distribution:** Survives at a few sites within the original range, in Bingham and Franklin counties, Idaho. We are currently surveying southeastern Idaho for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Known sites are on Caribou National Forest and (apparently) BLM lands.

**Idaho distribution and comments:** Very limited portions of the Snake drainage in southeastern Idaho; and likely a very narrow endemic in this region, found in Idaho only.

**Specific Idaho sites:** Just two: 939, 991.

**Threats:** Most small springs in southeastern Idaho have been heavily impacted by grazing and either are dry or no longer have mollusks. Diversion and capping, even of small springs, for stock use, even on public lands, is very common. The small springs preferred by this species, and many western *"Lyogyrus"* species, are particularly vulnerable to human-induced modification.

**Criteria for inclusion:** Local endemic; loss of most of known and potential habitat; occurrence on public lands.

**Recommended status:** This taxon has no special status at present; minimally, it should be considered Sensitive by Forest Service, BLM, and other land management and wildlife agencies. There has been sufficient recent survey work to justify Federal and State (Idaho) listing of this species as Endangered.

**References:** Deixis collections, 1990-1994.

### *Physa* (*Haitia*) *natricina* Taylor, 1988
### Snake River physa

**Type locality:** Snake River, Gooding County, Idaho, in rapids on east side, SW 1/4 SE 1/4 sec. 21. T 6 S R 13 E; holotype LACM 2256.

**Description:** For best description and illustrations, see Taylor (1982c unpub., 1988b). "Shell with inflated body whorl, planes of aperture and growth lines conspicuously oblique to axis of coil, and coarse axial sculpture of crowded, irregular raised threads, Tentacle with a dense black core of melanin in the distal half only; body otherwise nearly colorless. Penial complex consisting of a preputium bearing a preputial gland about one-third its length, with internally two pilasters and a massive, pyriform sarcobellum bearing a distal papilla; and of a penial sac, swollen proximad, that is only slightly longer than the preputium" (Taylor, 1988b, p. 67).

**Discussion:** This taxon is best identified from living or preserved specimens. The species has a rather ventricose body whorl, so that earlier whorls appear less rapidly expanding; the plane of the aperture and the orientation of the growth lines are both conspicuously oblique to the coiling axis. The shell sculpture of numerous, irregular, crowded, continuous raised axial threads; on less coarsely sculptured shells, the axial sculpture initially consists of fine, low, raised threads interrupted into series of spirally aligned crescentic arcs; these may continue onto the body whorl or be replaced by the more typical slightly coarser uninterrupted axial threads. In dorsal view, the living animal as seen through the shell is amber in color. See Taylor (1988b) for more complete discussion. Live specimens of this species are very distinctive, particularly in terms of visceral coil and body color.

**Ecology:** Occurs in relatively unimpacted areas, often with spring influence, in a medium-sized river; sites are rapid or riffles and generally have moderate-swift current; gravel-boulder substrate (generally basalt-derived); and few macrophytes or epiphytic algae. Associates include *Fluminicola* sp., *Taylorconcha serpenticola*, and *Vorticifex effusa effusa*. The lithophile tendencies and perilithon feeding habits are unusual for physids.

**Original distribution:** A limited reach of the middle Snake River, Elmore, Gooding, and Owyhee counties, Idaho; see discussion in Taylor (1982c unpub., 1988b) and USFWS (1992d) for fossil and recent historic range.

**Current distribution:** Survives at very few sites within the original range.

**Idaho distribution and comments:** Limited portion of the middle Snake River; strict Idaho endemic.

**Specific Idaho sites:** Well known to USFWS. Which, if any, of these sites remains viable needs to be checked again, due to river disturbance and continued poor water quality in the whole of the historic range.

**Threats:** Much of the middle Snake River is rapidly becoming eutropified, due to agricultural runoff, fish farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. Introduction of exotic mollusk species (Bowler, 1991) may also be a factor in the species' decline. This taxon is declining, in terms of area occupied and number of sites and individuals. Recent rather extensive survey of much of the middle Snake (see references under Frest & Johannes, *e.g.*; see also USFWS (1992d)) make it highly unlikely that significant range expansion or increase in the number of sites will occur. We have recently (1991-1994) surveyed over 500 sites in southeastern Idaho without finding this taxon, except as a fossil.

**Criteria for inclusion:** Local endemic; loss of historic sites; substantial decrease in available habitat and its condition.

**Recommended status:** Currently listed as Endangered federally (USFWS, 1990, 1992d); this is now under court challenge. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There has certainly been more than sufficient recent survey work on this taxon to demonstrate that it should be Federal and State (Idaho) Endangered.

**References:** Taylor (1982c unpub., 1988b); USFWS (1992d); Deixis collections, 1988-1990.

### *Physa* (*Physa*) *megalochlamys* Taylor, 1988
### large-mantle physa

**Type locality:** Lily pond beside US 26/89/187, NW 1/4 sec. 19, T 45 N R 114 W, Teton County, Wyoming (Snake River drainage). Holotype LACM 2255; paratypes UCM 30260. See Wu & Brandauer (1982) for UCM types.

**Description:** Best description and illustrations are those of Taylor (1988b), *q.v.* Shell thin, fragile, ovoid-fusiform, with blunt apex and narrow spire; whorls about 4 1/2; length *ca.* 12 mm; mantle broadly reflected over major portion of shell on both sides; mantle digitations broadly rounded, in just two groups. Shell surface usually silky; axial sculpture fine growth lines with occasional very weak raised threads; spiral sculpture consists of straight to curved fine ridges, convex in the direction of growth. For internal anatomy and more detailed description, see Taylor (*op. cit.*).

**Discussion:** The large, thin shell and extensive overfolded mantle are distinctive. The only similar species is *Physa skinneri*, which is smaller and has much less extensive shell coverage by the mantle.

**Ecology:** "Mostly found in extensive marshes or ponds, fluctuating or even drying seasonally" (Taylor, 1988a, p. 61). Substrate is often fine muds; *Typha-Scirpus* marshes are frequent locations for colonies. Feeding habits unknown; a pelophile species.

**Original distribution:** Probably widespread across southern Canada and the Pacific Northwest and Rocky Mountain states east of the Cascades to western Montana, Utah, and Colorado: Taylor, (1988b, p. 61). See distribution map in same publication.

**Current distribution:** Taylor, (1988b, p. 61) lists and maps about 16 scattered historic sites, 2 in Saskatchewan; 2 in western Montana; 1 in Utah; 1 in CO; 1 in Idaho; 4 in northwestern Wyoming; and 5 in the

Interior Basin of Oregon. Relevant here are the Montana, Oregon, and Wyoming sites, which include ones in the National Bison Range near Moiese, Lake County, Montana; Yellowstone National Park; and Harney and Malheur National Wildlife Refuge and adjacent BLM lands, Malheur County, Oregon.

**Idaho distribution and comments:** Potentially, this taxon could occur widely in this state, specifically in the Washingtonian Province portions; and potentially in southeastern Idaho as well. However, brief searches in a number of sites with proper habitat were unsuccessful.

**Specific Idaho sites:** See Taylor (1988) for single Idaho site.

**Threats:** Draining and dredging of marshes; treatment of wetlands and marshes with insecticides and pesticides; eutropification from agricultural runoff and irrigation diversion and returns; urbanization and other construction-related destruction of marshes and swamps.

**Criteria for inclusion:** Regional endemic known from relatively few sites; known impacts to historic sites and to rather limited habitat generally.

**Recommended status:** Currently has none. Minimally, it should be considered a Sensitive species by the Forest Service, BLM, and other relevant land management and wildlife agencies. Should probably be a Federal and State (Oregon, Utah, Montana, and Wyoming) Threatened species and Idaho Endangered species.

**References:** Taylor (1988b): Deixis collections, 1997.

### *Pyrgulopsis bruneauensis* Hershler, 1990
### Bruneau hot springsnail

**Type locality:** Springs along west side of Bruneau River, about 100 m down flow from the confluence of Hot Creek, SW 1/4 sec. 34, T 7 S R 6 E, Owyhee County, Idaho; holotype USNM 860507; paratypes 860508.

**Description:** For comprehensive description and illustration of both shell and soft part morphology see Hershler (1990, 1994). The long penial filament, short base and accessory lobe, and simple penial ornament (single small terminal lobe) are distinctive. We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus.

**Discussion:** This is one of a small group of western US thermopile *Pyrgulopsis* species, most or all of which tend to be highly endemic. Known occurrences are typically of single endemic species from single springs or spring groups widely separated from each other geographically. Other examples are *Pyrgulopsis* n. sp. 8 [Indian Hot springsnail, *q.v.*]; *Pyrgulopsis* n. sp. 4 (Owyhee hot springsnail), the extinct *Pyrgulopsis brandi* (Drake, 1953); and C2 candidate *Pyrgulopsis thermalis* (Taylor, 1987). For summary information, see USFWS (1985, 1993).

**Ecology:** This is a thermophile species (effectively a warm water stenotherm or homoiothermophile), found in small spring runs and very small (probably formerly confluent) seeps. Macrophytes are generally absent; flow is often over bare basalt bedrock surfaces. Very few other mollusks occur with this taxon. For detailed ecology and presumed life history, see Mladenka (1992). The species is primarily a lithophile and an aufwuchs grazer, mostly from rock surfaces, but also from plants and wood.

**Original distribution:** Uncertain; thermopile *Pyrgulopsis* mostly are highly endemic. The ground water table in the area of occurrence has been lowered considerably by overpumping ("mining") for agriculture, and flow in the largest spring inhabited reduced to a trickle, as contrasted to former status as one of the larger Idaho springs.

**Current distribution:** Limited to a small stretch along lower Hot Creek and adjacent Bruneau River, Owyhee County, Idaho.

**Idaho distribution and comments:** A Hot Creek, and very limited stretch of the adjoining Bruneau River endemic.

**Specific Idaho sites:** Consult Mladenka (1992).

**Threats:** Groundwater withdrawals; grazing; overcollecting; human sabotage.

**Criteria for inclusion:** Local endemic; loss of most of historic habitat; specialized habitat; occurrence on public lands (mostly BLM).

**Recommended status:** Recently (USFWS, 1985, 1993) listed federally as Endangered. The listing has been challenged successfully in court; appeal and relisting procedures are currently under way. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Obviously should be Federal and State (Idaho) Endangered. USFWS handling of this species has been criticized in an independent study (GAO, 1993a).

**References:** Hershler (1990, 1994); Mladenka (1992).

### *Pyrgulopsis idahoensis* (Pilsbry, 1933)
### Idaho springsnail

**Type locality:** Snake River at Homedale, Owyhee County, Idaho; lectotype ANSP 152677; paralectotype ANSP 396960. See Hershler (1994) and Baker (1964).

**Description:** For comprehensive description and illustration of both shell and soft part morphology see Hershler (1994); see also Taylor (1982f unpub.). We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus.

**Discussion:** This species is one of several included in *Fontelicella* (*Natricola*) by Gregg & Taylor (1965). Despite synonymy by Hershler (1994), the group remains somewhat distinctive in morphology and distribution. Details of the shell, penis, and internal anatomy distinguish this taxon from *Pyrgulopsis hendersoni*, the most closely related species.

**Ecology:** A medium-river form, found mostly on cobble substrate in clear, cold, water, in spring-influenced riffles. Macrophytes (including *Ceratophyllum*, *Elodea*, *Potamogeton crispus* and *filiformis*) and epiphytic algae may be present, but not as dense beds. This species is a perilithon grazer and lithophile, as are many *Pyrgulopsis* species. Common associates include such cold-water forms as *Fluminicola* sp., *Taylorconcha serpenticola*, and *Fisherola nuttalli*.

Relatively few *Pyrgulopsis* species are amniphiles or amnicoles; most are crenophilic. The related lower Columbia River springsnail *Pyrgulopsis* n. sp. 7 and *Pyrgulopsis* n. sp. 14 [Teton River springsnail; *q.v.*] are the best analogues.

**Original distribution:** Middle Snake River, probably from about the Weiser area to Glenns Ferry, *i.e.*, Canyon, Ada, Owyhee, and Elmore counties, Idaho. The record in Branson, Sisk, & McCoy (1966) is erroneous.

**Current distribution:** In recent years, found only in about 4 sites; see USFWS (1993) for details. The condition of these sites, all downstream from the Bliss landslide of 1993, needs to be rechecked.

**Idaho distribution and comments:** See above; a middle Snake River (and Idaho) endemic. Because of continued water quality problems and landslide into the Snake in the vicinity of Hagerman, the old sites need rechecking.

**Specific Idaho sites:** See above. A recent (1997) site on the Bruneau River needs rechecking.

**Threats:** Much of the middle Snake River is rapidly becoming eutropified, due to agricultural runoff, fish farms, and urbanization along the river corridor. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. Much of the middle Snake is also impounded, and this species does not seem to tolerate such impoundments. A recent (1993) landslide near Bliss, Idaho may have impacted all of the historic sites. Introduction of exotic mollusk species (Bowler, 1991) may also be a factor in the species' decline. This taxon is declining, in terms of area occupied and number of sites and individuals. Recent rather extensive survey of much of the middle Snake (see references under Frest & Johannes, *e.g.*; see also USFWS (1993)) make it highly unlikely that significant range expansion or increase in the number of sites will occur. We have recently (1991-1994) surveyed over 500 sites in southeastern Idaho without finding this taxon.

**Criteria for inclusion:** Local endemic; occurrence on public lands (BLM); serious and ongoing degradation of all of habitat; loss of historic sites, including the type locality.

**Recommended status:** This species is at present federally listed as Endangered (USFWS, 1990, 1992d). A legal challenge to the listing is currently being pursued. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (Idaho) Endangered; much recent information and survey work is available (see above).

**References:** Pilsbry (1933); Taylor (1982f unpub.); Hershler (1994); Deixis collections, 1988-1992.

### *Pyrgulopsis kolobensis* (Taylor, 1987)
### Toquerville springsnail

**Type locality:** Toquerville Springs, Washington County, Utah, T 40S, R 13 W, sec. 35 (Hershler, 1994); holotype LACM 2216 (holotype of *P. pinetorum*: LACM 2217); topotypes in NMNH.

**Description:** Shell typically ovate–conic; height 2.8-4.0 mm; whorls 3.75-4.5; teleoconch whorls moderately convex, sometimes slightly shouldered; aperture ovate, narrowly adnate or slightly separated from the body whorl; penis large, filament short; penial lobe rectangular in section, medium length; penial gland present, single usually, often small, confined to base of filament; Dg1 often well-developed; Dg2 often present also, generally a rather narrow strip; terminal gland usually rather large, curved (Hershler, 1994, 1998; see for detailed description).

Hershler (1998) includes populations with or without a Dg1and /or Dg2, with or without a proximal gland, and with considerable variation in morphology of the terminal and penial glands. This degree of variation in my observation never occurs in a single population; and there are regional limits to variation and distinct regional forms. Likely, this is a species complex; but conservative treatment is justified in the absence of more detailed study, such as mtDNA work.

**Discussion**: This is one of the most broadly distributed of the Great Basin springsnails, as now interpreted by Hershler (1999). Originally reported from the Virgin River drainage in Utah (Hershler, 1994), this taxon and its putative synonym *P. pinetorum* have now been extended to include sites in much of the Bonneville Basin, a few sites in the Bear River drainage, and sites in a few smaller isolated small basins (Hershler, 1998).

**Ecology:** Found in various-sized springs, at varying elevation as presently construed. This includes a number of slightly thermal or slightly hypersaline springs as well as more typical cold oligotrophic settings. Idaho populations

occur just in cold oligotrophic springs with normal salinity. This is one of the few eurythermic or poikilothermophile *Pyrgulopsis* species.

**Original distribution:** Quite widely distributed in the old Lahontan drainage, as broadly construed to include the Bonneville Basin and Bear River drainage, Utah, Nevada, and Idaho.

**Current distribution:** See **Discussion** above. Most sites are in Utah or Nevada, in portions of the old Lahontan drainage Basin, as broadly construed.

**Idaho distribution and comments:** Only 7 known sites, all in part of the Bear River drainage, SE Idaho: see below for details.

**Specific Idaho sites:** Hershler (1998) lists seven Idaho sites in Franklin, Bannock, and Oneida counties, all in the Bear River drainage.

**Threats:** The usual panoply of problems apply here also; groundwater drawdown; diversion and capping for agricultural usage; overgrazing by domestic animals; diversion for human water supply; road building and improvements, etc.

**Criteria for inclusion:** Quite rare in Idaho. Idaho populations seem to represent basically a single morphology. It is quite possible that this taxon is composite, in which case bear River populations could represent an endemic Idaho, rather rare, Bear River taxon.

**Recommended status:** Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be State (Idaho) Endangered; federal status overall requires further work: Should be at least Sensitive on Idaho public lands; Watch list in Utah; Watch list in Nevada.

**References:** Taylor (1987); Hershler (1994, 1998); Deixis collections, 1991-1994.

### *Pyrgulopsis* n. sp. 7
### Benson springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This small species is a member of a group of undescribed taxa restricted to portions of the southeastern Idaho Snake River and Bear River drainages.

**Discussion:** Attempts to identify western *Pyrgulopsis* species from shells only, even when they could belong to described species, is unwise if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon (with R. Hershler).

**Ecology:** This taxon is a crenophile preferring large and swift cold springs. *Rorippa* and *Veronica* are abundant in much of the area inhabited by this snail; locally *Chara* may be abundant also, and a small epiphytic algal component is present also. The most common associated mollusk is *Fluminicola* sp. Substrate ranges from local mud to gravel and cobbles. This species appears to be a perilithon and periphyton feeder.

**Original distribution:** Probably confined to the Sublett Range and vicinity, Power and Cassia counties, upper Snake River drainage, Idaho.

**Current distribution:** Currently known from a single spring complex in Power County, Idaho. We are currently surveying southeastern Idaho for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. The Sublett Range is divided between private, BLM, and Sawtooth National Forest ownership.

**Idaho distribution and comments:** See above; a strict Idaho endemic, probably limited to parts of the Sublett Range.

**Specific Idaho sites:** A single known site, 1684.

**Threats:** This spring complex is used as a source for a private fish hatchery. It is also grazed; many springs in this area lack mollusks due to heavy grazing.

**Criteria for inclusion:** Very local endemic; current and ongoing threats; possible occurrence on public lands.

**Recommended status:** Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992.

## *Pyrgulopsis* n. sp. 8
## Indian Hot springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This small subglobose snail is a member of a group of species with much reduced penial glands. This taxon has none; the accessory lobe is absent, and the penial base and filament are essentially continuous.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon (with R. Hershler).

**Ecology:** A thermopile taxon at home in both warm, shallow, and low-velocity seeps and larger, swift spring runs with abundant macrophytes (some introduced; also *Potamogeton filiformis* and *Elodea*) and various warm spring algal epiphytes and encrusting forms, including both red and calcareous green algae. The substrate ranges from mud to travertine gravel and sand to basalt cobbles. This species is primarily a lithophile and periphyton grazer.

**Original distribution:** Probably confined to a few warm springs in the Deep Creek Mountains, Power County, Idaho.

**Current distribution:** Confined to portions of a private resort. We are currently surveying southeastern Idaho for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Most of the Deep Creek Mountains are BLM public lands.

**Idaho distribution and comments:** A thermophile probably restricted to a single spring complex; very narrow Idaho endemic.

**Specific Idaho sites:** Three nearby sites: 1105, 2134, 2135.

**Threats:** Further resort development; groundwater drawdown in the immediate area; conflicting water rights on the drainage including the sites; heavy grazing of most other springs in this area. Introduced fishes and mollusks are common at the sites. Other warm springs in the Deep Creek Mountains have been grazed out or are now dry from various causes. Additional sites for this taxon are very unlikely.

**Criteria for inclusion:** Very local endemic with very unusual habitat; possible occurrence on public lands.

**Recommended status:** Currently has none. It at least should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to show that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992, 1994.

### *Pyrgulopsis* n. sp. 9
### Birch Creek springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This relatively large, high conical species is a member of a group of species characteristic of parts of the upper Snake River and Bear River (including Lake Bonneville) drainages. It was regarded by Taylor (1985a) as a member of the *Fontelicella* (*Natricola*) species group of Gregg & Taylor (1965). We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they could belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus.

**Discussion:** We are currently working on this taxon (with R. Hershler). This species was first found by D. W. Taylor in the late 1950s-early 1960s. Affinities are with such species as *Pyrgulopsis robusta* and other peripheral Great Basin forms. Taylor (1977, unpub.) had selected the name *Fontelicella betulina* (currently a *nomen nudum*) for this taxon.

**Ecology:** A lithophile species, feeding on both perilithon and periphyton organisms. This species prefers larger cold springs and spring pools, but can range to spring sources. It is found at depths ranging from less than an inch to about 14". Substrate ranges from minor mud to limestone and basalt gravel and cobbles. Macrophytes are common at sites, and include *Rorippa*, *Veronica*, *Chara*, *Myriophyllum*, and *Mimulus*. The most frequent associate is *Stagnicola hinkleyi*. Much of the area is bog and fen, with seven rare plant species, including the narrow endemic and federal listing candidate *Primula alcalina*: see Mosely (1992) for comprehensive discussion of the plants.

**Original distribution:** Probably restricted to portions of the Birch Creek Valley, between the Lemhi Range and Beaverhead Mountains, Lemhi and Clark counties, Idaho.

**Current distribution:** Known only from a few springs tributary to Birch Creek, mostly on Targhee National Forest and Idaho Department of Fish & Game lands, Lemhi County, Idaho. We are currently surveying southeastern Idaho for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Other lands in the area are owned by Salmon District BLM or are private. This species seems once to have inhabited Birch Creek, but runoff, grazing, and channel modification now seem to limit it to tributaries.

**Idaho distribution and comments:** An Idaho (southeastern only: Lemhi Range) endemic; see above for details.

**Specific Idaho sites:** So far, five sites: 940, 992, 993, 1469, 1671.

**Threats:** Much of the area is heavily grazed (horses and cattle), which has eliminated much or all of the native mollusk fauna from some springs in the complex. Many of the springs in this valley have been trashed by stock usage and/or diversion; some mapped are now dry.

**Criteria for inclusion:** Local endemic; occurrence on private lands; current and ongoing threats.

**Recommended status:** Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to show that this species should be Federal and State (Idaho) Endangered.

**References:** Taylor (1977, unpub., 1985a); Deixis collections, 1990, 1991, 1994.

## *Pyrgulopsis* n. sp. 10
## Rock Creek springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This large, subconical species was regarded by Taylor (1985a) as a member of the *Fontelicella* (*Natricola*) species group of Gregg & Taylor (1965). It is related to such species as *Pyrgulopsis robusta*. We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus.

**Discussion:** We are currently working on this taxon (with R. Hershler). This species was first found by D. W. Taylor in the late 1950s-early 1960s. The manuscript name (Taylor, 1977, unpub.; a *nomen nudum*) for this taxon was *Fontelicella petricola*.

**Ecology:** A lithophile species, feeding on both perilithon and periphyton organisms. This species prefers larger cold springs and spring-fed creeks, and is largely a crenocole. Substrate ranges from minor mud to limestone gravel and cobbles. Macrophytes are common at sites, and include *Rorippa*, *Veronica*, *Chara*, *Myriophyllum*, and *Mimulus*. The most common mollusk associate is *Fluminicola* sp. Depth ranges from about 2" to more than 12"; this snail can range to spring sources.

**Original distribution:** Probably widespread in the Rockland Valley, between the Sublett Range and Deep Creek Mountains, Power County, Idaho (upper Snake River drainage).

**Current distribution:** Occurs at a couple of sites on BLM public lands, in one fork of Rock Creek.

**Idaho distribution and comments:** Another of the few Sublett Range sites: strict Idaho endemic.

**Specific Idaho sites:** 1583-1585.

**Threats:** The sites are in a public campground, with human usage and grazing causing some impacts. Most springs mapped in this valley are now dry or grazed to the point that none of the native mollusk fauna remains. As we are currently surveying southeastern Idaho for springsnails (1991-1994), along with R. Hershler *et al.* (1993-1994), significant range extension or discovery of sizable numbers of new sites are not to be expected from future work.

**Criteria for inclusion:** Local endemic; loss of most potential habitat; current and continuing threats.

**Recommended status:** Currently, this species has no special status. Minimally, it should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to show that this species should be Federal and State (Idaho) Endangered.

**References:** Taylor (1977 unpub.; 1985a); Deixis collections, 1992-1993.

### *Pyrgulopsis* n. sp. 11
### Pauline springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This small, high-spired form with strongly convex whorls is a member of a group of undescribed taxa restricted to portions of the southeastern Idaho Snake River and Bear River drainages.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon (with R. Hershler).

**Ecology:** This hydrobiid is a crenophile preferring smaller cold springs. *Rorippa* and *Mimulus* are abundant in much of the area inhabited by this snail; locally *Chara* may be abundant also, and a small epiphytic algal component is present also. The most common associated mollusk is *Fluminicola* sp. Substrate ranges from local mud to basalt gravel and cobbles. This species appears to be both a perilithon and periphyton feeder. The snail is found mostly in very shallow water, with moderate velocity flows.

**Original distribution:** Probably confined to the Arbon Valley, between the Deep Creek Mountains and the Bannock Range, Power and Oneida counties, upper Snake River drainage, Idaho.

**Current distribution:** At present known from a single spring complex in Power County, Idaho. We are currently surveying southeastern Idaho for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Much of the Valley is private; the Deep Creek Mountains are largely administered by the BLM; the Bannock Range is largely in Caribou National Forest. A few sites in these areas are possible.

**Idaho distribution and comments:** A strict Bannock Range and hence Idaho endemic.

**Specific Idaho sites:** Only three: 1691-1693.

**Threats:** This spring complex has been heavily impacted by highway construction and maintenance (Arbon Valley Hwy.). Parts of the spring complex have been dug out, other areas are diverted into an irrigation ditch. The snail is absent from these areas. Most of the surviving colony is on the highway right-of-way, while the bulk of the spring complex is on the Ft. Hall Indian Reservation. Most of the complex is also grazed; many springs in this area are dry or lack mollusks due to heavy grazing.

**Criteria for inclusion:** Very local endemic; current and ongoing threats; occurrence on public lands.

**Recommended status:** At present, this species has no special status. It should at least be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992-1994.

## *Pyrgulopsis* n. sp. 12
## Bannock springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This large species is a member of a group with unique penial characters inhabiting limited portions of the upper Snake River and Bear River drainages, southeastern Idaho.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they could belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon (with R. Hershler).

**Ecology:** This taxon is a crenophile inhabiting larger cold springs and their runs. *Rorippa* and *Veronica* are abundant in much of the area inhabited by this hydrobiid; locally, *Chara, Elodea,* and *Ceratophyllum* may be abundant also, and a small epiphytic algal component is present also. The most common associated mollusk is *Colligyrus* sp. cf. *greggi.* Substrate ranges from local mud to basalt gravel and cobbles; but in some areas is largely travertine "sand" and gravel. This species appears to be both a perilithon and periphyton feeder. Most areas with it are very cold; clear, and shallow.

**Original distribution:** Probably confined to the northern Bannock Range, Bannock County, Portneuf River (upper Snake River) drainage, Idaho. Could have once occurred in the Portneuf River valley between the northern Bannock and Portneuf ranges, Bannock County, although searches in the area involved in the 600,000 YBP Portneuf basalt flow have thus far been unsuccessful.

**Current distribution:** Currently known from a single nasmode and nearby individual spring in Bannock County, Idaho. We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Much of the Bannock Range is largely in Caribou National Forest. A few sites in these areas are possible.

**Idaho distribution and comments:** An Idaho and more strictly Bannock Range endemic.

**Specific Idaho sites:** Two sites: 879, 992.

**Threats:** This spring complex has been grazed; many springs in this area are dry or lack mollusks due to heavy grazing. Part of the spring flow has been diverted for use as the Pocatello municipal water supply.

**Criteria for inclusion:** Very local endemic; current and ongoing threats; occurrence on public lands.

**Recommended status:** At present, this species has no special status. It should at least be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992-1994.

## *Pyrgulopsis* n. sp. 13
## Brush Creek springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This medium-sized, low conical *Pyrgulopsis* is a member of a group with unique penial characters inhabiting limited portions of the upper Snake River and Bear River drainages, southeastern Idaho.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon (with R. Hershler). This taxon was originally discovered in the late 1950s-early 1960s by D. W. Taylor.

**Ecology:** This taxon is a crenophile inhabiting cold springs and their runs. *Rorippa* is abundant in much of the area inhabited by this hydrobiid, and a sizable epiphytic algal component is present also, the latter likely due to pollution by cattle. Substrate is mostly travertine sand and gravel; water is cold, fast, and shallow. This species appears to be both a perilithon and periphyton feeder, and occurs with few other mollusks (mostly small sphaeriids).

**Original distribution:** Probably confined to the Marsh Valley and southern Bannock and Portneuf ranges, Bannock County, Portneuf River (upper Snake River)drainage, Idaho. Could have once occurred in the Portneuf River valley between the northern Bannock and Portneuf ranges, Bannock County, although searches in the area involved in the 600,000 YBP Portneuf basalt flow have thus far been unsuccessful.

**Current distribution:** Currently known from a single spring and its run in Bannock County, Idaho; the old Taylor site is now extirpated. We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Much of the Bannock Range is in Caribou National Forest. The southern Portneuf Range has extensive areas of State of Idaho lands, possibly including the site with this species. A few additional sites in these areas are possible.

**Idaho distribution and comments:** An Idaho endemic, likely limited to the Marsh Creek Valley.

**Specific Idaho sites:** 930.

**Threats:** The only live site has been grazed; many springs in this area, including one in this group, are dry or lack mollusks due to heavy grazing. The lower site has been impacted by agricultural use; ground water apparently carries a heavy nutrient load. Highway realignment and construction (I-15; US 91) also seems to have impacted the original site.

**Criteria for inclusion:** Very local endemic; current and ongoing threats to habitat; occurrence on public lands.

**Recommended status:** At present, this species has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, State of Idaho, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992-1994.

## *Pyrgulopsis* n. sp. 14
## Teton River springsnail

**Type locality:** None; to be designated when species is described.

**Description:** This large-sized, low conical *Pyrgulopsis* is a member of a group with unique penial characters inhabiting limited portions of the upper Snake River and Bear River drainages, southeastern Idaho.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this species (with R. Hershler). This taxon was originally discovered in the late 1950s-early 1960s by D. W. Taylor. It has been considered (Taylor, 1977, unpub.; 1985a) a member of the genus *Fontelicella* (*Natricola*). The manuscript name (Taylor, 1977, unpub.; still a *nomen nudum*) was *Fontelicella tetonica*.

**Ecology:** This taxon is a crenophile inhabiting large cold springs, their runs, and spring-influenced creeks and a small river. *Rorippa* is abundant in much of the area inhabited by this hydrobiid, and a small epiphytic algal component is present also. Sites commonly have extensive *Elodea*, *Ceratophyllum*, *Chara*, *Potamogeton filiformis*, *Veronica*, and occasionally *Myriophyllum* beds. The substrate is variable; but commonly includes mud, sand, some gravel, and a minor basalt cobble component; water is very cold and clear; flow ranges from fast to slow; and depth from a few inches to nearly 3 ft. This species appears to be primarily a pelophile, and hence a detritivore; but also may engage in perilithon and periphyton feeding as well. It occurs with common sphaeriids and *Fluminicola* sp.

**Original distribution:** Probably confined to the Teton Basin, Teton River (Henrys Fork-upper Snake River) drainage, Teton County, Idaho. Could once have occurred throughout the valley between the eastern Big Hole Mountains and western Teton Range (mostly Targhee National Forest) Teton County, although searches elsewhere in the area have thus far been unsuccessful.

**Current distribution:** Currently known from a few sites in the headwaters of the Teton River; at least one of the 2 old Taylor sites is now extirpated. We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. Much of the northwestern part of the Basin is heavily agriculturalized, and we have thus far found no remaining live sites here. In general, sites in the Henrys Fork area, involved in comparatively recent volcanism and caldera formation (especially the Island Park Caldera), lack *Pyrgulopsis*.

**Idaho distribution and comments:** An unusual Idaho amniphile endemic, found only in the upper portions of the Teton River.

**Specific Idaho sites:** About 6 live sites: 994, 995, 997, 1204, 1687, 1688.

**Threats:** The Basin was once extensive marsh and fen-bog terrain. Much has been drained and channeled, and is now being grazed. Many springs in this area, including one in the headwaters, may lack mollusks due to heavy grazing. The river has been affected by agricultural use, including nutrient and chemical runoff and channeling. Ground water in some areas apparently carries a heavy nutrient load. Road location, maintenance, and spraying have sometimes affected sites and potential sites.

**Criteria for inclusion:** Very local endemic; current and ongoing threats to habitat; possible occurrence on public lands.

**Recommended status:** At present, this species has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, State of Idaho, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1992-1994.

## *Pyrgulopsis* n. sp. 15
## Blackfoot springsnail

**Type locality:** None; to be designated when species is described.

**Description:** A very distinctive subglobose form with a ribbon-like penial base and unique configuration of penial glands. No other Idaho species closely resembles this taxon.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they may belong to described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this species (with R. Hershler).

**Ecology:** Occurs in a medium-sized spring and associated pool, in limestone terrain. The spring is very cold, clear, and swift in the areas where the hydrobiid is abundant. *Rorippa* is abundant near the source, and *Mimulus* common. *Veronica* and *Chara* are common in the pool. The substrate near the source is limestone cobbles. A crenophile species, not successful in establishing itself in the large creek of which the spring is a tributary. This taxon is predominantly a lithophile and hence a perilithon grazer.

**Original distribution:** Probably confined to the Blackfoot Mountains and adjoining upper Blackfoot River valley, Bingham County, Idaho.

**Current distribution:** Known only from a single site just outside of BLM public lands in the Blackfoot Mountains. None of the other springs in this drainage had this species (or other hydrobiids). We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. The Blackfoot Mountains have substantial State of Idaho, BLM, and private holdings.

**Idaho distribution and comments:** An Idaho endemic and perhaps the only Blackfoot Mountains endemic as well.

**Specific Idaho sites:** Only one known site, 2020.

**Threats:** Most of the springs in this area have been heavily grazed, and now have small, no, or uninteresting mollusk faunas. Others have been capped and/or diverted for stock water supply. The only known site for this species has been modified; a berm and pipe creates an artificial pool, in which the hydrobiid does poorly. It is thus limited to a few tens of square feet of source area.

**Criteria for inclusion:** Very local endemic; current and ongoing threats; possible occurrence on public lands; recent surveys of much or all of known and potential habitat.

**Recommended status:** Currently, this recently discovered taxon has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1994.

## *Pyrgulopsis* n. sp. 16
## Warm Springs springsnail

**Type locality:** None; to be designated when species is described.

**Description:** A distinctive mid-sized subconical form with a unique configuration of penial glands, related to a group of species found only in the upper Snake River and Bear River drainages.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells alone if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this species (with R. Hershler).

**Ecology:** This taxon is found in about half of the springs in a single sizable nasmode. The springs (which are cold, not warm) are very cold, clear, and slow-moderate in the areas where the hydrobiid is abundant. *Rorippa* is abundant in shallow areas, and *Mimulus* locally common. *Veronica* and *Chara* are common in the deeper areas and pools. The substrate ranges from mud to limestone gravel and cobbles. Travertine is locally abundant, and sometimes a major substrate contributor. A crenophile species, not successful in establishing itself in the large run of which the springs are sources. This taxon is predominantly a lithophile and hence a perilithon grazer.

**Original distribution:** Probably limited to the south flank of the Snake River Range and adjacent upper Snake River valley, Bonneville County, Idaho.

**Current distribution:** Known only from a single spring complex in Targhee National Forest. Other springs in the vicinity (*e.g.,* Antelope Flat) lacked this species. We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. The Snake River Range has substantial Targhee National Forest and private holdings.

**Idaho distribution and comments:** An Idaho endemic, limited to a single large spring complex in the Snake River Range.

**Specific Idaho sites:** Three known sites: 2044-2046.

**Threats:** Most of the springs in this area have been heavily grazed, and now have little, no, or uninteresting mollusk faunas. Others have been capped and/or diverted for stock water supply. The sites for this species has been modified to varying degrees. Modifications include channeling, road rip-rap and diversion, and impoundment. Much of the area is indicated as Bureau of Reclamation and agency power withdrawals.

**Criteria for inclusion:** Very local endemic; current and ongoing threats; occurrence on public lands; recent surveys of much or all of known and potential habitat.

**Recommended status:** Currently, this recently discovered taxon has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1994.

### *Pyrgulopsis* n. sp. 17
### Wilson Flat springsnail

**Type locality:** None; to be designated when species is described.

**Description:** A distinctive mid-sized subconical form with a unique configuration of penial glands, related to a group of species found only in the upper Snake River and Bear River drainages.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this species (with R. Hershler).

**Ecology:** This taxon is found in about half of the springs in a single large formation spring nasmode. The springs range from cold to very cold; most area with hydrobiids are also clear, and have slow-moderate flow. This species is abundant in limited areas of spring run, spring source, and limnocrene. *Rorippa* is abundant in shallow areas, and *Mimulus* locally common. *Veronica* and *Chara* are common in the deeper runs and pools. The substrate is mostly travertine sands, gravel, and cobbles. This taxon is a crenophile, absent from nearby creeks without spring influence. It is predominantly a lithophile and hence a perilithon grazer. In most occurrences, it is the dominant mollusk.

**Original distribution:** Probably limited to the east edge of the Blackfoot Lava Field, upper Blackfoot drainage, Caribou County, Idaho.

**Current distribution:** Known only from a single spring complex in mixed private and BLM ownership. Other springs in the area (*e.g.,* Chesterfield Range) lacked this species. We are now surveying southeastern Idaho comprehensively for springsnails (1991-1994), as is R. Hershler *et al.* (1993-1994). Significant range extension or discovery of sizable numbers of new sites are not to be expected from future work. The area has substantial Bureau of Reclamation, BLM, and private holdings.

**Idaho distribution and comments:** Endemic to the state and apparently only to the Blackfoot drainage.

**Specific Idaho sites:** A total of seven sites; 2074-2080.

**Threats:** Most of the springs in this complex have been heavily grazed, and now have little, no, or uninteresting mollusk faunas. Some mapped springs are now completely dry. Others in the area have been capped and/or diverted for stock water supply. The sites for this species has been modified to varying degrees. Modifications mostly involve channeling, diversion, and impoundment. This is an excellent, and one of the few surviving examples of a formation spring complex in Idaho, second in quality only to TNC's Formation Springs Preserve near Soda Springs, Idaho (Bear River drainage).

**Criteria for inclusion:** Very local endemic; current and ongoing threats; occurrence on public lands; recent surveys of much or all of known and potential habitat.

**Recommended status:** This recently discovered taxon has no special status currently. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Deixis collections, 1994.

## *Pyrgulopsis* n. sp. 18
## Jim Sage springsnail

**Type Locality:** None designated as yet; undescribed species.

**Description:** This species is a small, moderately high conic taxon with penile characters characteristic of a small subset of species from the upper Snake River tributary drainages.

**Discussion:** We do not recommend attempts to identify western *Pyrgulopsis* species from shells only, even when they are described species, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus. We are currently working on this taxon with R. Hershler (NMNH).

**Ecology:** A crenophile found in seeps and small to medium-sized shallow springs. The regolith is basalt; substrate ranges from mud to cobbles, with coarse substrate being characteristic of areas with common springsnails. Macrophytes are limited (mostly *Rorippa*) and epiphytic algae may be present in polluted areas, but rather rare in places with common hydrobiids. Few other mollusks (essentially, just *Physella* sp. and *Pisidium insigne*) are present.

**Original distribution:** Probably common in the Raft River valley and surrounding ranges (east side of the Cotterel and Jim Sage Mountains, and possibly Black Pine Mountains and west side of the Sublett Range, Cassia County, Idaho).

**Current distribution:** A few sites in the Cotterel and Jim Sage Mountains, Cassia County, Idaho. Included are sites on BLM lands (including a campground) and State of Idaho lands.

**Idaho distribution and comments:** An Idaho endemic, found on the flanks of the Cotterel and Jim Sage Mountains.

**Specific Idaho sites:** There are about 5 live sites: 2006-2009, 2013.

**Threats:** Most springs in this area have been heavily affected by grazing, and many springs on the appropriate USGS 7.5' maps either are now dry or have uninteresting or no mollusks. Springs have also been extensively capped and/or used for stock water supply. Springs with this species have been grazed and/or dug out, with the result that the species persists in some only in protected situations. Low-elevation springs either no longer exist or appear to have enriched ground water recharge, *i.e.,* are algae-choked and lack interesting mollusks.

**Criteria for inclusion:** Local endemic; occurrence on public lands; current and ongoing threats to its somewhat specialized habitat.

**Recommended status:** This recently discovered taxon has no special status currently. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho) Endangered.

**References:** Smithsonian collections, 1993; Deixis collections, 1994.

## *Pygulopsis pilsbryana* (Baily & Baily, 1952)
## Bear Lake springsnail

**Type locality:** Lifton, Ideal Beach, Bear Lake, Idaho; holotype ANSP 187691; paratypes ANSP 368401. While Hershler (1994, 1998) does not emphasize this, the species was based originally upon Holocene fossils. Hershler's (1994) description is based upon live material from an unnamed spring ca. 0.6 km NW of Lakota, Rich County, Utah, T 14N, R 5E, NE 1/4 sec. 5.

**Description:** Shell rather tall conical, height 2.7-5.0 mm; whorls 4-5; teleoconch whorls strongly convex and strongly shouldered; aperture usually adnate; penis large, filament medium length, narrow; lobe short and tapered distally; penial gland complement of terminal, penial, and Dg3; penial weak, covering filament base only; Dg3 small, weak, near outer edge close to base of filament; terminal gland horizontal, distal, mostly on ventral surface; filament pigmented (see Hershler, 1994, 1998 for excellent detailed description).

Hershler (1998) ascribes a much larger set of sites to this taxon than does Hershler (1994). In the latter work, Hershler states that "[p]opulations ....vary principally in terms of shell shape and length of the penial gland." I would note that adult size and body color also differ quite strongly from population to population. For example, some populations, including those very close to Bear Lake itself, have rather large elongate shells and bodies and mantles with little pigment. The Formation Springs population has small elongate shells with black bodies and mantles. Another population near The Cove has small, rather low conical shells, generally orange in color. In my opinion, this taxon as now construed is likely to prove a species complex; but is best treated as has the last revisor, at least until mtDNA or similar work can be done. Even with all populations recognized by Hershler included, this is a rather rare endemic, limited to the Bear River drainage.

**Discussion**: This is one of the more broadly distributed of the Great Basin springsnails, as now interpreted by Hershler (1998). Hershler records sites in Bear Lake County, Caribou County, and Franklin County in Idaho, as well as sites in NE Utah and 1 in Wyoming.; a total of 14 sites.

**Ecology:** This taxon occurs mostly in large cold springs, including formation springs

**Original distribution:** Probably quite widespread in the Bear Lake drainage; and formerly in Bear Lake itself.

**Current distribution**: A total of 14 sites; 1 in Wyoming; 3 in Utah; and 10 in Idaho, all in rather close proximity in a limited part of the Bear River drainage.

**Idaho distribution and comments:** See Hershler (1998) for details on the 10 Idaho sites.

**Specific Idaho sites:** See above. Note that the majority of known populations occur in Idaho or quite close to the Idaho border.

**Threats:** Many springs in this region have been heavily affected by grazing, and many springs on the appropriate USGS 7.5' maps either are now dry or have uninteresting or no mollusks. Springs have also been extensively capped and/or used for stock water supply. Springs with this species have been grazed and/or dug out, with the result that the species persists in some only in protected situations. Low-elevation springs either no longer exist or appear to have enriched ground water recharge, *i.e.*, are algae-choked or somewhat saline. Bear Lake itself appears to now lack this species, although Holocene fossils are quite common.

**Criteria for inclusion:** Regional endemic; occurrence on public lands; current and ongoing threats to its somewhat specialized habitat and rather narrow occurrence area.

**Recommended status:** This taxon has no special status currently. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to establish that this species should be Federal and State (Idaho, Utah, Wyoming) Endangered.

**References:** Baily & Baily (1952); Hershler (1994, 1999); Deixis collections, 1991-1994.

### *Stagnicola* (*Stagnicola*) *hinkleyi* (Baker, 1906)
### rustic pondsnail

**Type locality:** "North fork Snake River, east Idaho"; syntypes CHAS; ANSP; UCM 9778. See Wu & Brandauer (1982) for UCM types.

**Description:** See Baker (1906) for description and illustration and Burch (1989, fig. 620) for modern illustration. This rather large stagnicolid has a short spire, dark red shell, and relatively few, moderately inflated whorls.

**Ecology:** This taxon is one of a small group of species with atypical habitat as compared to more widespread lymnaeids. It is a stenothermal amniphile, found mostly in larger, relatively swift, cold, oligotrophic streams with coarse (gravel to boulder) substrate. This species appears to be largely a perilithon grazer and lithophile (also atypical for the family). Other species with similar habits (and also with limited geographic ranges) are *Stagnicola apicina* (*q.v.*) and *Stagnicola idahoensis* (*q.v.*). We have not found this taxon in the more typical stagnicolid habitats of backwaters, ditches, ponds, small streams, or streams with slow flow and other lotic characters. Common associates are *Fluminicola* sp., *Physella gyrina*, and, in limited areas, such taxa as *Taylorconcha serpenticola* and *Pyrgulopsis idahoensis*. See discussion in Frest & Johannes (1992) for more details.

**Original distribution:** Taylor (1977, unpub.) gives the distribution as Crater Lake, Oregon; mainstem Snake River from southern Idaho upstream to Jackson Lake, Wyoming; Birch Creek, Lemhi County; Yellowstone Lake and upper Madison and Yellowstone rivers, Wyoming; upper Colorado River drainage, southwestern Wyoming.

**Current distribution:** The species survives in Crater Lake and in Birch Creek; almost all of the many southern Idaho middle and upper Snake historic sites (the bulk of the distribution) are now extirpated. We have had no luck in the Wyoming Snake River in recent years in finding this species alive. We have not rechecked the Yellowstone National Park sites as yet. The upper Colorado River sites appear to have been extirpated. The middle Snake system has been extensively surveyed for mollusks in recent years; see USFWS (1992d) and references herein (Frest & Johannes, in part) for details. We have recently surveyed many sites in southeastern Idaho (approximately 500) while finding this species in just a few, mostly in springs tributary to Birch Creek. Sites with (or mostly formerly with) this species are on BLM, Bureau of Reclamation, US Fish & Wildlife Service, Idaho Department of Fish & Game, and National Park Service lands.

**Idaho distribution and comments:** Originally from the Middle Snake River through the upper Snake River and some large southeastern tributaries, such as Birch Creek. Most middle Snake sites are extinct; perhaps most upper Snake as well. Survives in Birch Creek and at a few Wyoming sites. The Oregon site was rather dubious, so that the bulk of the historic distribution was in Idaho.

**Specific Idaho sites:** One each in the middle Snake, upper Snake (Henry's Fork) and Birch Creek: 218, 992, 2022.

**Threats:** Many parts of the Snake system have been impounded, which appears inimical to this species. Nutrient enhancement and sedimentation deleteriously affects the great majority of the range; the species is absent from sites with such features. The Snake River in Idaho has been declared water quality impaired by the EPA and the State of Idaho.

**Criteria for inclusion:** Local endemic; extensive range and historic site loss; current and ongoing threats.

**Recommended status:** Currently, this species has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, Bureau of Reclamation, and other land management and wildlife agencies. Sufficient survey work has been done to show that this species should be Federal and State (Idaho, Oregon, Wyoming) Threatened. Status in Nevada uncertain; and no recommendation is made at present.

**References:** Baker (1906); Deixis collections, 1988-1994, 1996.

### *Stagnicola* (*Stagnicola*) *idahoensis* (Henderson, 1931)

**shortspire pondsnail**

**Type locality:** Little Salmon River, 16 mi. north of New Meadows [*i.e.*, near Pinehurst, Adams/Idaho counties, Idaho]; holotype UCM 17486a; paratypes 17486, 174896b. See Wu & Brandauer (1982) for UCM types.

**Description:** See Henderson (1931a) and Burch (1989, fig. 619). The only western species at all like this one in morphology is the lower Columbia River (Washington, Oregon) *Stagnicola apicina*. This species has a shorter spire; and the brown shell color and dark body are also distinctive field characters.

**Ecology:** Listed as *Stagnicola idahoense* in Burch (1989). This taxon is one of a small group of species with atypical habitat as compared to more widespread lymnaeids. It is a stenothermal amniphile, found in larger, relatively swift, cold, oligotrophic streams with coarse (gravel to boulder) but stable substrate. This species appears to be largely a perilithon grazer and lithophile (also atypical for the family). Other species with similar habits (and also with limited geographic ranges) are *Stagnicola apicina* (*q.v.*) and *Stagnicola hinkleyi* (*q.v.*). We have not found this taxon in the more typical stagnicolid habitats of backwaters, ditches, ponds, small streams, or streams with slow flow and other lotic characters. Common associates are *Gonidea angulata*, *Fisherola nuttalli* [Salmon River only], and *Fluminicola fuscus* [Salmon River only]. The taxon avoids areas with sand, mud, or bedrock substrate. Generally, macrophytes or epiphytic algae are rare or absent at sites with this species.

**Original distribution:** Lower portions of Little Salmon River, Idaho and Adams counties, and lower Salmon River from about French Creek Bridge to White Bird, Idaho County, Idaho.

**Current distribution:** Still survives in parts of the original range. We did not find this species in the lowermost Salmon River, the Salmon River east of the River of No Return, uppermost half of the Little Salmon River, or in Hells Canyon. Sites with this species are on BLM and Payette and Nez Perce National Forest lands.

**Idaho distribution and comments:** Taylor has from time to time varied on the range of this taxon, so that Taylor & Bright's (1987) range differs from that of Taylor (1985). We accept the species as valid, as does Turgeon et al. (1998), and confined to the Little Salmon and parts of the lower Salmon River. Thus, the whole range is in Idaho.

**Specific Idaho sites:** 1569.

**Threats:** Disturbance of the substrate for hydraulic gold mining, dredging for gravel, and changes brought about by bridge and highway construction (*e.g.*, in the vicinity of Riggins and of White Bird) are the primary problems. Jet boating may also be a problem.

**Criteria for inclusion:** Local endemic; continuing and ongoing threats; loss of much of range to human activities.

**Recommended status:** Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient survey work has been done in recent years (*e.g.*, Neitzel & Frest, 1989, 1993) to indicate that this species should be Federal and State (Idaho) Threatened.

**References:** Henderson (1931a); Deixis collections, 1990, 1991, 1994, 1996.

***Taylorconcha serpenticola* Hershler *et al.*, 1994**
**Bliss Rapids springsnail**

**Type locality:** Thousand Springs (north springs), SW 1/4 sec. 8, T 6 S R 14 E, Gooding County, Idaho; holotype USNM 860853; paratypes USNM 874558, UF 194616.

**Description:** This small, generally orange-colored hydrobiid is not easily confused with other taxa in its range, except for juveniles. See Hershler *et al.* (1994) for detailed description and illustrations; see also Taylor (1982d, unpub.).

**Discussion:** Even with a recently described monotypic genus such as this, we do not recommend attempts to identify western hydrobiid species from shells only, if they come from a region like this in which discovery of additional similar taxa is quite possible. Hence, we refrain from a description here. Consultation with a specialist is *de rigueur* for this genus.

**Ecology:** This species is primarily a crenocole, found in springs in various sizes; but does occur in spring-influenced parts of a short stretch of the middle Snake River as well (it is a crenophile, not an amniphile); see Hershler *et al.* (1994) for detailed discussion. Mollusk associates include *Pyrgulopsis idahoensis*, *Physa* (*Haitia*) *natricina*, *Stagnicola hinkleyi*, *Lanx* n. sp. 1, and *Fluminicola* sp. This species is primarily a lithophile and a perilithon grazer. The Shoshone sculpin also occurs at several sites with this species.

**Original distribution:** Part of the middle Snake River drainage from about Indian Cove Bridge to Twin Falls; see Hershler *et al.* (1994) for detailed discussion.

**Current distribution:** Survives in limited areas in the original range (Hershler *et al.*, 1994). Most spring and river populations have been extirpated or are much reduced.

**Idaho distribution and comments:** Idaho (middle Snake River endemic genus (we do not accept the site from near Blackfoot: see Hershler *et al.*, 1994, for details).

**Specific Idaho sites:** Listed in detail in Hershler *et al.* (1994). Some examples, some of which may now be extirpated: 206-208; 210, 212, 213, 218-223; 229-235.

**Threats:** Springs have been diverted and/or capped for livestock, industrial, domestic, or piscicultural water supply. Many springs have had agricultural waste water diverted into them. Ground water pollution from dairy farm runoff and wells is a major concern. Siltation and impoundments are major problems throughout the middle Snake River drainage. The middle Snake River has been declared water quality impaired by the EPA. A recent landslide (1993) may have extirpated many of the remaining river populations. Illegal dumping of fish manure has recently (1997) affected another major population set.

**Criteria for inclusion:** Local endemic; occurrence on public lands; current and ongoing threats; reduction in range and loss of historic sites; monotypic genus.

**Recommended status:** Currently federally listed as Threatened (USFWS, 1990, 1992d). The listing has been challenged unsuccessfully in federal court. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent work has been done to demonstrate that this species should be Federal and State (Idaho) Threatened.

**References:** Taylor (1982d, unpub.); Hershler *et al.* (1994); Deixis collections, 1988-1993.

## *Valvata* n. sp. 1
## Salmon valvata

**Type locality:** None as yet; will be designated when the species is formally described.

**Description:** This small (generally < 2 mm diameter) species has a low, glossy shell, with a depressed spire, somewhat as in *Valvata perdepressa*. It is smaller than *Valvata humeralis*, more depressed; and the snout and cephalic tentacles are gray. Shell color ranges from greenish-gray to gray-brown

**Discussion:** The only taxon at all similar is an undescribed species known from a couple of Nevada sites. See key 2I (**APPENDIX A**) for comparisons with other taxa from the western US. The spring habitat is unusual for a valvatid.

**Ecology:** A crenocole species, found in relatively unimpacted to pristine large seeps to medium-sized cold springs. Commonly, the substrate is mud, with minor amounts of sand, gravel, or larger particles; bedrock may be either basalt or limestone. Few other mollusks, other than *Pristinicola hemphilli* and *Pisidium insigne*, co-occur. Springs with this taxon have been noted at low-medium elevations; the only commonly occurring macrophyte is *Rorippa*.

**Original distribution:** Lower Salmon River drainage, Idaho County, Idaho. We have looked for this species in the Snake River canyon elsewhere in Idaho (Hells Canyon), Oregon, and Washington to the mouth; and also in the upper part of the Salmon River system, Idaho, without success.

**Current distribution:** Found at a few sites in the lower Salmon River drainage. See Frest & Johannes (1995a) for discussion. We have collected mollusks in this area since 1988, and heavily since 1990; many other collectors have done likewise since the 1860s. Future large range extensions or finds of sizable numbers of new sites are very unlikely. Known sites are on Nez Perce National Forest, BLM, and private lands.

**Idaho distribution and comments:** Certain distribution is in Idaho only; and there only in lower Salmon River springs.

**Specific Idaho sites:** 1548, 1567.

**Threats:** There are very few remaining relatively undisturbed low to medium elevation springs in the lower Salmon River drainage. Most springs are subject to heavy gazing; many others have been capped or diverted for stock water supply. Others have been damaged or destroyed by road construction and maintenance. Others have been diverted or capped for domestic water supply, campgrounds, etc.

**Criteria for inclusion:** Very local endemic; heavy human impact on all of range; continuing and ongoing threats; occurrence on public lands.

**Recommended status:** This newly discovered taxon currently has no special status. It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (Idaho) Endangered.

**References:** Frest & Johannes (1995a); Deixis collections, 1994, 1997.

### *Valvata utahensis* Call, 1884
### desert valvata

**Type locality:** "Lake Utah, Utah....Utah Lake, near Lehi, not far from the mouth of the River Jordan" (Call, 1884), Utah County, Utah. Types USNM; paratypes MCZ.

**Description:** See Call (1884) for description and illustrations; see also excellent figure in Burch (1989, fig. 34). Shell diameter about 5 mm; depressed-conic; initial whorls almost flat; rounded periphery (no peripheral carina); single upper whorl carina initially sharp; often becoming more obtuse on the body whorl; basal carina low;

umbilicus narrow, open, about 1/6-1/7 full diameter. Shell color light gray, yellow-gray, or orangish gray; axial striae subdued, usually inconspicuous.

**Discussion:** This species in basic shell characters is unlike any other US species, except for variant specimens of *Valvata tricarinata*. Shell color and morphological details, as well as anatomy, are unique and not particularly close to *tricarinata*.

**Ecology:** See Taylor (1982e *unpub.*), USFWS (1990, 1992d) and Frest & Johannes (1992a) for discussion. This species is a detritivore, most at home in well-oxygenated, cool water situations; it generally occurs on soft but consistently oxygenated mud substrates, often calcareous. Common plant associates are *Chara*, *Elodea*, *Myriophyllum*, *Ceratophyllum*, and *Potamogeton* spp. Mollusks include sphaeriids, *Physella gyrina*, *Valvata humeralis*, and *Fluminicola* sp. It is generally an amniphile; but has been found in 2 limnocrenes. Generally, some flow is present; it is absent from most impoundment situations, unless sufficient flow and spring influence is present to prevent hypoxic or anoxic bottom conditions.

**Original distribution:** In the recent past, found live in the middle Snake River from about Weiser through American Falls; in Box Canyon, Idaho; and also at sites in southeastern Idaho and Utah Lake, Utah. For fossil range and biogeographic significance, see Taylor (1985a).

**Current distribution:** The southeastern Idaho site is extirpated; and we have recently searched over 350 sites in this area without finding this taxon, except as a fossil. The Utah site is also extirpated, as are most sites in the middle Snake River. Known to survive currently in one of the limnocrenes (another has endured a recent illegal dumping of fish manure) and a couple of Snake River sites.

**Idaho distribution and comments:** Most sites were in the middle Snake River proper and in Box Canyon. How many of these survive at present is uncertain. There was one site in southeastern Idaho, noted below; but that is believed extirpated.

**Specific Idaho sites:** Uncertainty persists as to how many of these are still viable. Those in Lake Walcott persist; those between Lake Walcott and American Falls are doubtful; and others need rechecking, as noted above. Some examples are: 471, 473, 476, 511, 1135-1139, 1141, 1143, 1145-1147, 1202.

**Threats:** Much of the middle Snake River is rapidly becoming eutropified, due to agricultural runoff, trout farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. Introduction of exotic mollusk species (Bowler, 1991) may also be a factor in the species' decline. Springs in this area have been impacted by ground water pollution from agricultural and dairy operations; diverted into irrigation systems; capped and diverted for stock, domestic, industrial, and piscicultural water supply; heavily grazed; and dried due to groundwater drawdown. This taxon is declining, in terms of area occupied and number of sites and individuals. Recent rather extensive survey of much of the middle Snake (see references under Frest & Johannes, *e.g.*; see also USFWS (1992d)) make it highly unlikely that significant range expansion or increase in the number of sites will occur.

**Criteria for inclusion:** Local endemic; loss of historic sites and much of range; continuing and ongoing threats.

**Recommended status:** Currently federally listed as Endangered (USFWS, 1990, 1992d). The listing has been challenged unsuccessfully in federal court. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (Idaho, Utah) Endangered.

**References:** Call (1884); Taylor (1982e, unpub.); USFWS (1992d); Deixis collections, 1988-1993.

## *Anodonta californiensis* Lea, 1852
## California floater

**Type locality**: "'Rio Colorado," actually a former distributary of the river, approximately New River, Imperial County, California. " (Taylor, 1981, p. 142); holotype USNM 86393; three paratypes MCZ 161905.

**Description:** For best description and illustrations, see Burch (1973, 1975b, fig. 70b). This form does not closely resemble other described western anodontids, except for *Anodonta wahlametensis* [*q.v.*]. That species has a much more conspicuous wing and different beak sculpture. This taxon has a blunt wing and more rounded posterior slope. Most specimens have a length of between 10 and 12 cm.

**Discussion:** This species has been confused in the literature with *Anodonta nuttalliana nuttalliana* and with *Anodonta nuttalliana idahoensis.* The best treatment is that of Taylor (1977, unpub.; 1981), who regards *Anodonta nuttalliana nuttalliana* as a synonym of *Anodonta wahlametensis* and *Anodonta nuttalliana idahoensis* as a synonym of *Anodonta californiensis.* It should be noted that the lectotype of *Anodonta nuttalliana idahoensis* was fixed by Johnson & Baker (1973), according to ICZN (1985), Article 74 b, c; and treatment of type material by Coan & Roth (1987, p. 324) is thus incorrect. As noted by Taylor (1981), there is some chance that *Anodonta californiensis* is a composite species; this needs to be carefully studied. One implication would be that protection is more justified, in that all component taxa would have limited ranges, and the whole group is already known to have been much reduced in range and abundance. This species was cited also in Frest & Johannes (1993c, 1995b).

We have recently (1995, 1998) examined much of the museum material for this taxon, with particular attention paid to the collections of the NMNH and CAS. This leads us to believe even more strongly than Taylor that the species may be composite. Briefly, material from the Colorado River system, including the holotype, tends to be rather strongly and distinctly rayed with medium green; the animal is relatively small and somewhat inflated; the wing is much reduced. The coloration is somewhat suggestive of *Anodonta dejecta.* Material from southern Idaho, Utah, western Wyoming, and much of Nevada seems to indicate a slimmer, more alate form with rather distinctive, somewhat light olive, often unrayed shell, much like that of *A. wahlametensis*, although never so strongly alate. Washington, southern British Columbia, Oregon, and northern California material seems to belong to a weakly rayed, greenish-brown form with a moderate wing and rather produced posterior margin. Note that a number of names, including *A. nuttalliana* and *A. nuttalliana idahoensis*, may be involved here. By our reckoning, the WA-OR form may be "*nuttalliana*" (holotype NMNH 86391) and the ID-NV form "*nuttalliana idahoense*" (holotype NMNH 105602). Treatment of these forms is complicated by several factors. One is that holotypes of three nominal species, *wahlametensis* Lea (NMNH 7086), *nuttalliana* Lea, and *oregonensis* Lea (NMNH 85073) are from the Willamette River near its junction with the Columbia River, Oregon. For discussion of this site, see entry for *Fluminicola fuscus.* It is quite possible that three *Anodonta* species once occurred in this large river; but in recent years we have only been able to collect *A. oregonensis* from it. The adjacent lower Columbia does seem to maintain populations of all three, however. Another difficulty is that Lea seems to have chosen rather small specimens as holotypes for *wahlametensis* and for *nuttalliana* (the holotype of *oregonensis* is an unusually large, and old, specimen). It can be difficult to distinguish smaller specimens of these taxa from each other, and large, more typical in our view, supposed Lea paratypes apparently were available for both taxa (NMNH, MCZ). Hence, there is some possibility that *nuttalliana* and *wahlametensis* might be synonyms based on their respective types, even though rather distinct morphologic entities with largely non-overlapping distributions are involved. *Wahlametensis* occurs disjunctly in the lower Columbia River (and possibly the former mouth of the Willamette); but more typical material derives from northeastern California: see entry below and Taylor, 1981, 1985).

**Ecology**: "Lakes and slow rivers" (Taylor, 1981, p. 142), generally on soft substrates (mud-sand), in fairly large streams and lakes only, in relatively slow current. A low elevation species, found in both lakes and lake-like stream environments; basically a limnophile. A filter-feeder, as are all unionaceans. The host fish for the glochidial stage of this bivalve is (are?) unknown; note that the fate of the fish larval host(s) also limits and determines the distribution of this species.

**Original distribution**: Lower Willamette and lower Columbia rivers in Oregon and Washington from The Dalles to the mouth. In larger slow streams of northern California as far south as the northern San Joaquin Valley. The former range includes Wahkiakum, Cowlitz, Clark, Skamania, and Klickitat counties, Washington; Clatsop, Columbia, Multnomah, Hood River, and Wasco counties, Oregon; and Siskiyou, Shasta, Lassen, Modoc, and Tehama counties, California; Snake River drainage of southern Idaho (mostly mainstem Snake; but including large tributaries such as Salmon Falls Creek, Bruneau River, Wood River, Portneuf River. [Note: extralimital distribution includes southern BC; Bear River drainage in southwestern Wyoming, where now apparently extinct; parts of northern and western Utah, where now probably extinct; parts of the Humboldt drainage in Nevada, where now believed extinct. Survives in small numbers in Arizona].

**Current distribution**: Taylor (1981) reports that this species is probably eradicated over much of its original range. We have not found living specimens in the Willamette and lower Columbia River in searches from 1988-1990. Still survives in the Fall River and Pit River, Shasta County, California (1991); some possible specimens collected by USFWS near The Dalles, 1990. Apparently extinct in the upper Sacramento River. Also survives in the Okanogan River, Chelan County, Washington, Parts of Roosevelt Lake, Ferry County, Washington (pers. comm., T. Burke, 1994), and Curlew Lake, Ferry County, Washington. This species was likely heavily impacted by the BPA dams and impoundments; see comments under *Physella columbiana*. Of the over 500 Columbia Basin sites surveyed by Frest & Neitzel (Neitzel & Frest, 1993), only three had live or recently dead specimens of this species. It is clearly declining in numbers and in area occupied throughout its range. The species appears to be extinct or nearly extinct in Utah and Nevada (see, *e.g.*, Clarke & Hovingh, 1993) and is very limited in distribution in Arizona. The middle Snake River populations are much circumscribed, but may be the best extant (Frest, 1992).

**Idaho distribution and comments:** The Idaho distribution was only a small portion of the total range: but extirpation in a number of areas has perhaps had the result of making the Idaho populations the best extant in the US. Could have occurred over the state originally. Current sites are mostly in the middle Snake River drainage, *e.g.* 427, 433, 434, 476, 500, 502, 1134, 1639.

**Specific Idaho sites:** See foregoing.

**Threats:** Extensive diversion of California rivers for irrigation, hydroelectric, and water supply projects has much reduced the California range of this species. This species can tolerate some water pollution; but not heavy nutrient enhancement or similar problems.

Much of the middle Snake River in Idaho is rapidly becoming eutropified, due to agricultural runoff, trout farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. Introduction of exotic mollusk species (Bowler, 1991) may also be a factor in the species' decline. Springs in this area have been impacted by ground water pollution from agricultural and dairy operations; diverted into irrigation systems; capped and diverted for stock, domestic, industrial, and piscicultural water supply; heavily grazed; and dried due to groundwater drawdown.

In the lower Columbia River region threats include impoundments; continued siltation and other impacts on the few remaining sites with habitat characteristics approximating pre-impoundment conditions on the lower Columbia. Harbor and channel "improvements" in the vicinity of Portland, The Dalles, and John Day Dam; nutrient enrichment of the lower Columbia due to agricultural run off. The Lower Granite Reservoir, Washington population noted by Frest & Johannes (1992b) appears to have been extirpated by the 1992 drawdown. Declines in numbers and/or distribution of the fish host(s) may also be involved.

This taxon is declining, in terms of area occupied and number of sites and individuals.

**Criteria for inclusion:** Current C2 Federal candidate; occurrence on public lands; affected by federal projects; current and ongoing threats.

**Recommended status**: Currently this species is a C2 candidate (USFWS, 1994a). It minimally should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to demonstrate that this species should be Federal and State (Oregon, Idaho, Washington, Arizona, Utah, Wyoming, and California) Threatened.

**References**: Burch (1973, 1975b); Taylor (1981); Frest (1992); Frest & Johannes, 1992b; 1993a, 1993b; Neitzel & Frest (1993); Deixis collections, 1988-1994, 1995-1997.

### *Margaritifera* n. sp. Taylor, 1988
### Pahsimeroi pearlshell

**Type locality:** None designated as yet; taxon not yet formally named (but see Taylor, 1988a). Reposited specimens include UCM 29279. See Wu & Brandauer (1982) for this material.

**Description:** "Anterior cardinal tooth of left valve about 1/4 of the size of the posterior; nacre pale orange on ventroanterior surface, pale purple elsewhere..."; "[t]he sinulus is strongly impressed, setting off the beaks prominently. Thus the dorsal margin is not broadly curved as in most other species of the genus, but has a pronounced concavity anterior to the beaks" (Taylor, 1988a, pp. 563, 564); see also illustrations in same work.

**Discussion:** This taxon bears some resemblance to Asian (Russian Federation) forms. See Taylor (1988a) for further discussion. There is considerable variation in *M. falcata*; but no population we have seen elsewhere than in the Pahsimeroi looks much like this, either in color or shell morphology.

**Ecology:** Found in gravel-cobble riffle in small river; typical *Margaritifera falcata* occurs at the same site. Surrounding ranges are mostly limestone and dolomite. An amniphile, found generally in swift streams, partly buried in coarse substrate; a filter-feeder.

**Original distribution:** Pahsimeroi River, Pahsimeroi Valley, Lemhi and Custer counties, Idaho.

**Current distribution:** Survives at at least one site on the Pahsimeroi River. Most of the land in this area is BLM-owned.

**Idaho distribution and comments:** Much of the Pahsimeroi is degraded: may survive only in spring-fed portions of the mainstem river, mostly near the upper end. An Idaho endemic.

**Specific Idaho sites:** Only vague sites.

**Threats:** Much of the Pahsimeroi River and larger tributary flowage is diverted into irrigation ditches and returns, which have caused most of the system to become nutrient-enriched and sediment- and macrophyte-choked (and hence unsuitable habitat). Grazing is heavy through much of the Valley as well.

**Criteria for inclusion:** Very local endemic; ongoing threats; severe reduction in suitable habitat.

**Recommended status:** Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (Idaho) Endangered.

**References:** Taylor (1988a); P. Bowler (pers. comm., 1993).